United States
Department of
Agriculture

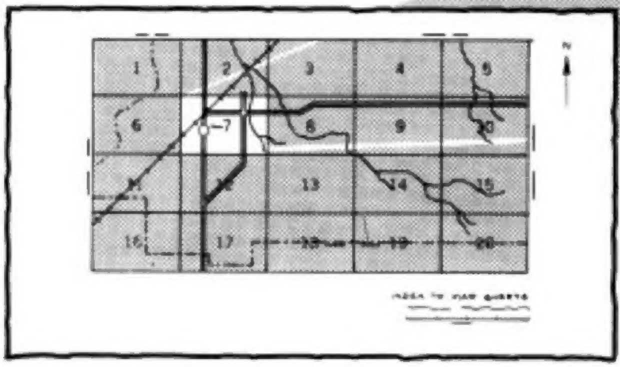
Soil
Conservation
Service

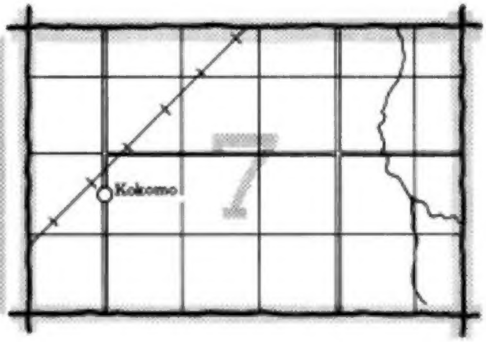
In cooperation with
Texas Agricultural
Experiment Station and
Texas State Soil and Water
Conservation Board

Soil Survey of Galveston County, Texas

HOW TO USE

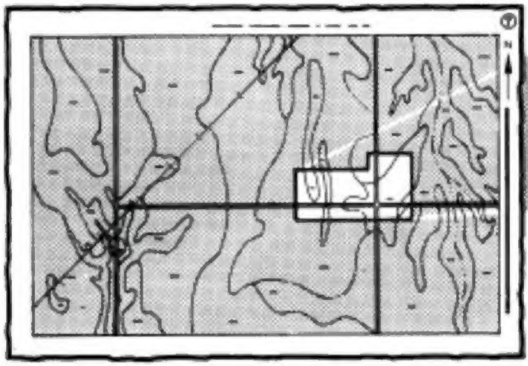
1. Locate your area of interest on the "Index to Map Sheets"

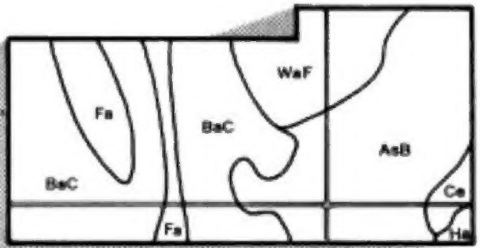




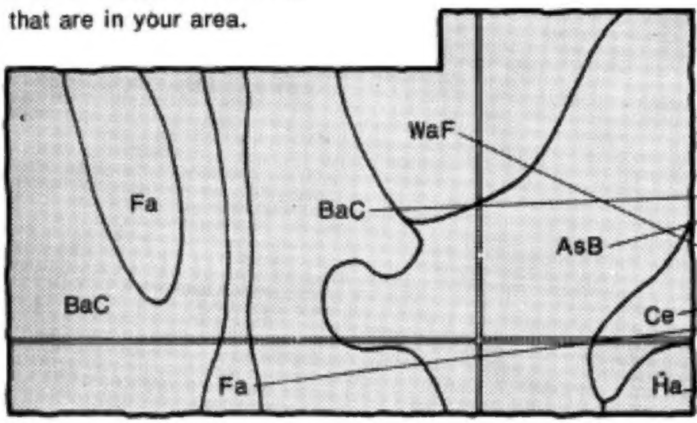
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.



Symbols

AsB
BaC
Ce
Fa
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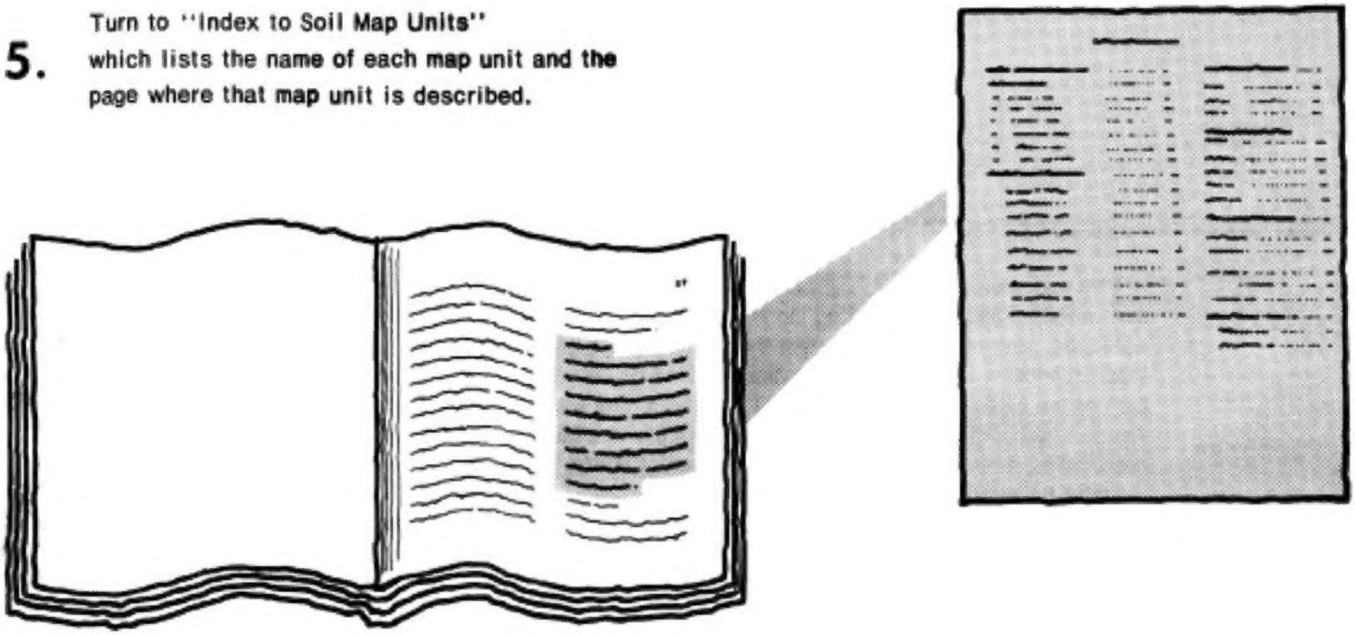
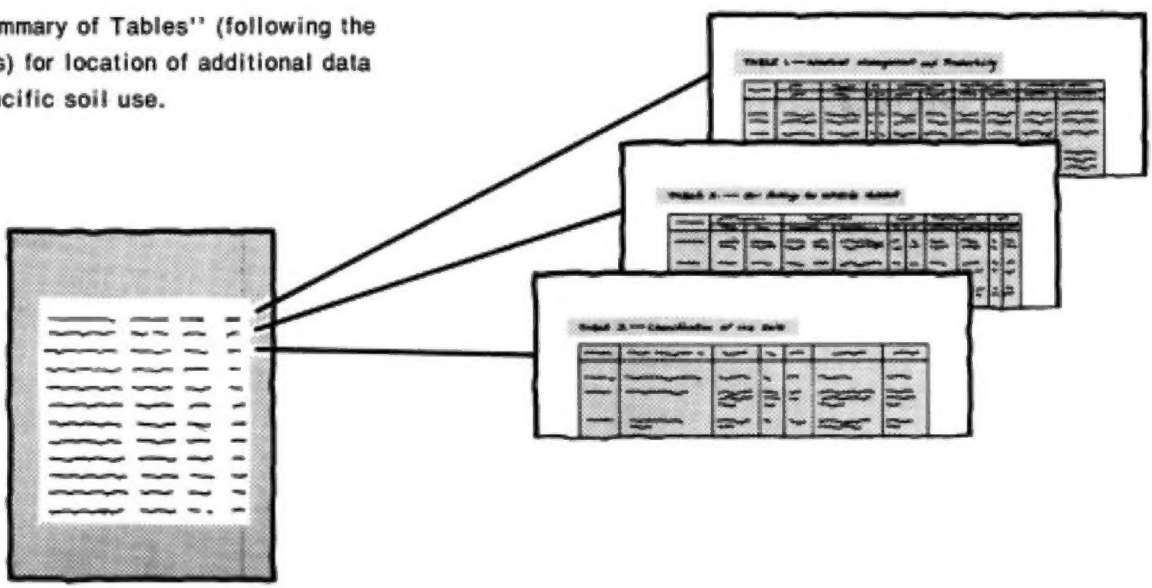
WaF

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1985. This soil survey was made cooperatively by the Soil Conservation Service, the Texas Agricultural Experiment Station, and the Texas State Soil and Water Conservation Board. It is part of the technical assistance furnished to the Waters Davis Soil and Water Conservation District and the Trinity Bay Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

This survey supercedes the soil survey of Galveston County published in 1930. Descriptions, names, and delineations of soils in this survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, differences in intensity of mapping, or differences in the extent of soils within the survey area.

Cover: These beach houses along the Gulf of Mexico on Galveston Island are on Mustang and Galveston soils. In the background is rangeland, interspersed with recreation cottages, on Karankawa soil.

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Soil Series

Issued February 1988

Index to Map Units

Summary of Tables

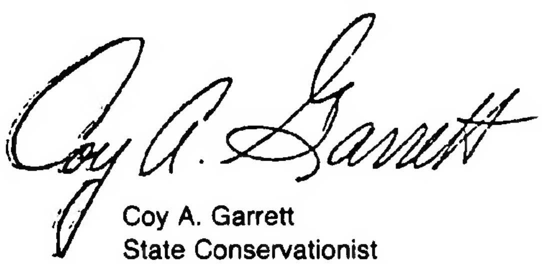
Foreword

This soil survey contains information that can be used in land-planning programs in Galveston County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

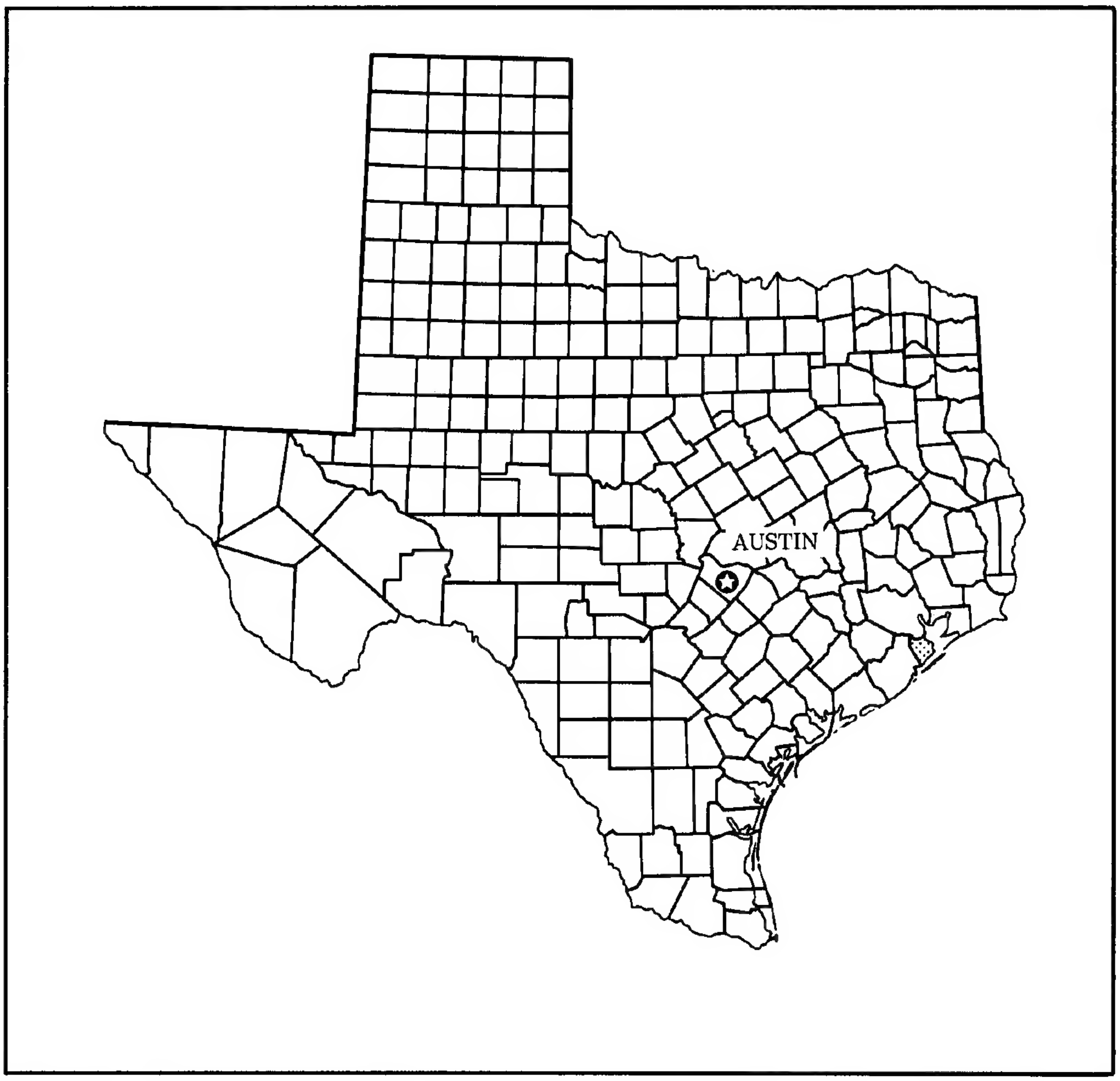
This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



Coy A. Garrett
State Conservationist
Soil Conservation Service



Location of Galveston County in Texas.

Soil Survey of Galveston County, Texas

By Gerald W. Crenwelge, Edward L. Griffin, and Janet K. Baker,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with the Texas Agricultural Experiment Station
and the Texas State Soil and Water Conservation Board

GALVESTON COUNTY is located in the southeastern part of Texas along the Gulf of Mexico. The county is in two major land resource areas; the Gulf Coast Prairies and the Gulf Coast Saline Prairies.

The county is triangular. Total acreage is 424,961 acres, of which 169,600 acres is water. The land area is 399 square miles, or 255,361 acres. Generally, the land surface can be characterized as broad and nearly level. Elevation ranges from sea level to about 45 feet in the northwest part of the county.

The population in 1980 was 195,940. Galveston, the county seat, had a population of 61,902. Other cities or towns with populations of more than 10,000 are Friendswood, LaMarque, League City, and Texas City.

Industry, shipping, tourism, and agriculture are the main enterprises.

General Nature of the Survey Area

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

The long summers are hot and humid, but the coast is frequently cooled by sea breezes. Winters are warm and are only occasionally interrupted by incursions of cool air from the north. Rain occurs throughout the year, and precipitation is adequate for all crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Galveston in the period 1951 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 47 degrees F, and the average daily minimum temperature is 33 degrees. The lowest temperature on record, which occurred at Galveston on February 1, 1951, is 17 degrees. In summer the average temperature is 83 degrees, and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred at Galveston on July 22, 1965, is 97 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 39.73 inches. Of this, 23 inches, or 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 16 inches. The heaviest 1-day rainfall during the period of record was 10.44 inches at Galveston on June 18, 1961. Thunderstorms occur on about 60 days each year, and most occur in summer.

Snowfall is rare. In 90 percent of the winters, there is no measurable snowfall. In 10 percent, the snowfall, usually of short duration, is less than 2 inches. The heaviest 1-day snowfall on record was about 2 inches.

The average relative humidity in midafternoon is about 70 percent. Humidity is higher at night, and the average

at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 9 miles per hour, in spring.

History

The history of Galveston County is enhanced by its unique location. This coastal area was visited and inhabited by many early explorers. Galveston County, located along the route used to ship goods up the Trinity River, was a major shipping artery for the early settlers.

The life of the native Indians, mainly the Karankawa Indians, was not easy *(15)*. Although the area had numerous kinds of animals, there were not enough of them to sustain human life yearlong. Therefore, the Indians were nomadic. Life for the Indians was also made more difficult because of the mosquito. The Karankawas smeared themselves with alligator grease to ward off the mosquito.

The early exploration and settlement in the county centered around Galveston Island, which was discovered by Juan de Grijalva in 1519 while he was exploring the Gulf Coast. It is believed that Cabeza de Vaca, an early Spanish explorer, was shipwrecked at Galveston Island in 1528.

The first settlement on the island was established in 1816 by a pirate, Louis-Michel Aury, who used it as a port for his operations. During one of his absences from the island in 1817, Jean Lafitte set up his base of operation. In 1821, Lafitte was ordered by the United States Navy to leave Galveston Island.

Permanent settlement of Galveston began in 1836. Congress made it a port of entry in 1837. The following year Galveston became a county by act of the State.

Because the port was considered to be the best in Texas, it rapidly became very active. The commercial trade consisted mainly of exporting cotton that was grown in the interior areas and transporting passengers to and from New Orleans. Galveston was also a port of entry for immigrants coming to the United States, mainly from Germany.

Galveston was linked to the mainland by a railroad in 1859. Prior to this, travel to and from Galveston was by boat *(10)*. Development slowed during the Civil War, but when the war was over, Galveston began to reestablish itself as a major port. Along with the port came businesses, banks, and hotels to complement the shipping industry. It became the financial center of Texas in the late 1800's.

However, the thriving city was dealt several blows that stymied its continued growth. In 1869, the city of Houston began dredging out Buffalo Bayou so ships could be unloaded there. Now, Galveston had Houston as a competitor for the shipping industry. Although competition from Houston for shipping directly affected the future growth of Galveston, other setbacks also played a role. Several outbreaks of yellow fever, major fires, and hurricanes affected the city in the 1800's.

Although the people of Galveston had been affected by floods and by hurricanes, they were not prepared for the devastation of the major hurricane *(30)*that struck Galveston on September 8, 1900. By the time the residents realized on that day that the water, wind, and waves were going to be very severe, it was too late to leave the island city. The highest land elevation on the island was 8.7 feet, but the water reached an elevation of 14.5 feet. An estimated 6,000 of the 20,000 residents lost their lives *(1)*. Although rebuilding began after the storm, Galveston never totally recovered from the loss *(18)*.

As a result of the storm, the city was determined that this kind of devastation would never happen again. In October 1902 through July 1904, a large, solid concrete seawall over 3 miles long was constructed along the shore. The seawall was later extended to offer additional protection.

The second undertaking involved the "grade raising" of the populated part of the city *(4)*. It was determined that the ground elevation needed to be raised to protect the buildings from the future devastation of flooding caused by hurricanes. The grade raising began in 1904. They began constructing a levee around one small area at a time in the city of Galveston. Most of the buildings, including large masonry ones such as churches, were lifted intact by jacks to raise them to a predetermined elevation. When all of the buildings within the leveed area were elevated and supported, water-soaked sand was pumped into the area from the jetties. The sand settled out and the water returned to the Gulf. The pumping continued until the area inside the levee was filled with sand. The buildings now were at ground level again. Although the depth varied greatly, the fills averaged about 5 feet, but some were as deep as 20 feet.

Much of the history of the mainland part of the county centered around the fact that it existed between two major cities of that time; Galveston and Houston. Dickinson was the site of the first settlement on the mainland some time prior to 1850. Agricultural products were easily transported to local markets or shipped to other markets. The early settlers were mainly cattle producers. Much of the land was used for cattle production since it was not drained well enough for consistent crop production. Dairy production also became a major enterprise in the 1900's. Most of the product was marketed at Galveston and Houston.

Truck crops, vegetable crops for local markets, and figs were the main crops grown on the better-drained soils by the 1930's. The major truck and vegetable crops included watermelons, cantaloupes, corn, potatoes, sweet potatoes, peanuts, turnips, beans, and cabbage *(19)*. Other crops included small areas of cotton, rice, and sorghum.

Galveston County was a major fig producing area *(9)*. The production in Texas was about 16,000 acres at its peak in about 1928 with Galveston County having about one-third of the acres. The local industry began on a commercial basis in about 1890. Figs were sold to local and distant canneries for processing; however, foreign competition, high land prices, high labor costs, overproduction, and the depression caused the decline of this industry. Today only a few small areas of figs are left.

Agriculture

The main agricultural enterprises in Galveston County are growing beef cattle and crops such as rice and soybeans. In some places, income is supplemented by leasing hunting rights, mainly for geese and ducks.

Livestock operations are mainly cow-calf. On prairie rangeland and pasture, supplemental feeding is generally needed in the winter. The marsh rangeland is used extensively by some larger operators to overwinter cattle. Little supplemental feeding is needed on marsh rangeland.

Rice is generally produced by tenant farmers who have a short-term lease from the landowners. Rice is commonly grown on a field for 1 or 2 years; then the field is fallowed or is used as pasture or for some other crop for 1 or 2 years. Because of the high cost of the land, more and more areas are being used for crop production instead of being fallowed or used for livestock production.

Vegetable crops are also an important crop in certain areas of the county.

Natural Resources

Galveston County has an abundance of natural resources.

The soils are productively used as cropland, pastureland, and rangeland, except for those in the marshes.

The marshes are productive rangeland. They not only provide grazing for cattle but also produce abundant organic matter, which is a necessary part of the food chain for the marine ecosystem. The marshes also provide breeding areas for many marine animals. In addition, they provide food for a large population of ducks and geese.

Oil and gas are also important resources in the county.

The extensive bays and bayous and the Gulf of Mexico provide abundant water recreation, fishing, and other water-related activities, which attract people from many areas.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; and the kinds of crops and native plants growing on the soils. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material from which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, distribution of plant roots, salinity, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory

analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or a building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, salinity, and other characteristics that affect management.

Land areas make up about 60 percent of the total acreage. Water areas make up the remaining acreage.

Deep, Nonsaline Soils of the Mainland

The five general soil map units in this group make up about 61 percent of the land area of Galveston County. The major soils are in the Algoa, Bacliff, Bernard, Edna, Kemah, Lake Charles, Leton, Mocarey, and Verland series. These soils are in broad, nearly level areas that are far enough inland that they are not affected by tides or salt from the Gulf of Mexico. They are somewhat poorly drained or poorly drained and have a high water table within 1 or 2 feet of the surface during the winter. The soils in these map units are loamy and clayey, and most are slowly permeable or very slowly permeable.

Most of the soils are, or have been, cultivated to rice, grain sorghum, or soybeans. Some acreage is used as pastureland and hayland. The productivity of these soils is generally better if a surface drainage system has been installed.

Some areas of these soils have been developed for urban use. The main limitations for urban use are wetness and the shrink-swell potential of most of the soils.

1. Mocarey-Leton-Algoa

Somewhat poorly drained or poorly drained, moderately slowly permeable or slowly permeable soils that are loamy throughout

This map unit makes up about 18 percent of the land area of the county. It is about 35 percent Mocarey soils, 14 percent Leton soils, 6 percent Algoa soils, and 45 percent other soils.

The soils in this map unit have slopes that are about 0.3 percent. The landscape has many old, filled stream meanders, shallow depressions, and pimple mounds. Mocarey soils are mainly on the broad, smooth parts of the landscape. Leton soils are in the old stream meanders and depressional areas. Algoa soils are mostly on the pimple mounds.

Mocarey soils are somewhat poorly drained and are slowly permeable. Typically, the surface layer is mildly alkaline, very dark gray loam about 12 inches thick. The upper part of the subsoil, to a depth of 22 inches, is dark gray clay loam. The middle part, to a depth of about 38 inches, is calcareous, light gray loam that has many masses of calcium carbonate. The lower part, to a depth of about 52 inches, is calcareous, light gray loam. The subsoil is moderately alkaline throughout. The substratum to a depth of 60 inches is moderately alkaline, light gray clay loam.

Leton soils are poorly drained and are slowly permeable. Typically, the surface layer is about 12 inches thick. The upper part is dark gray loam and the lower part is gray loam. It is neutral throughout. The upper part of the subsoil, to a depth of about 26 inches, is neutral, gray clay loam mixed with some gray loam material. The lower part to a depth of 60 inches is moderately alkaline, light gray clay loam.

Algoa soils are somewhat poorly drained and are moderately slowly permeable. Typically, the surface layer is mildly alkaline, very dark gray silt loam about 12 inches thick. The upper part of the subsoil, to a depth of about 18 inches, is grayish brown loam. The middle part, to a depth of about 43 inches, is light brownish gray loam. The lower part, to a depth of 58 inches, is light gray loam. The subsoil is moderately alkaline and calcareous throughout. The substratum to a depth of 65 inches is moderately alkaline, light gray loam.

The minor soils included in this map unit are Aris, Bernard, Cieno, Kemah, Lake Charles, Morey, and Verland soils. Aris and Kemah soils are in slightly higher positions on the landscape than Mocarey, Leton, and Algoa soils. Morey soils are generally in similar positions on the landscape as Mocarey soils. Bernard, Lake

Charles, and Verland soils are generally in slightly lower positions. Cieno soils are in slightly depressional areas.

The soils in this map unit are used mainly as pastureland, to which they are well suited or moderately well suited. Some areas are used as cropland, hayland, or rangeland. Soil wetness and uneven surfaces are the main limitations. A surface drainage system is desirable for increased yields and better grazing distribution. Some areas have been leveled to help control wetness. Leton soils are in the depressional areas, and these areas generally remain wet even after leveling.

Urban use is expanding across many areas of this map unit. Soil wetness is the main limitation for urban use.

2. Lake Charles-Bacliff

Somewhat poorly drained or poorly drained, very slowly permeable soils that are clayey throughout

This map unit makes up about 14 percent of the land area of the county. It is about 73 percent Lake Charles soils, 17 percent Bacliff soils, and 10 percent other soils.

The soils in this map unit have slopes that are about 0.1 percent. The landscape is a broad, smooth, plane surface except for occasional bayous or creeks that have short, gentle slopes along the side of them. Bacliff soils are slightly lower on the landscape than the Lake Charles soils.

Lake Charles soils are somewhat poorly drained. Typically, the surface layer is very dark gray clay about 24 inches thick. The upper part of the subsoil, to a depth of 51 inches, is dark gray clay. The lower part to a depth of 62 inches is gray clay. Reaction is medium acid grading to moderately alkaline.

Bacliff soils are poorly drained. Typically, the upper part of the surface layer is medium acid, dark gray clay about 9 inches thick. The lower part, to a depth of 35 inches, is neutral, gray clay. The subsoil to a depth of 63 inches is light gray clay. Reaction is neutral grading to moderately alkaline in the subsoil.

The minor soils included in this map unit are Bernard, Leton, Vamont, and Verland soils. Bernard and Verland soils are in slightly higher positions on the landscape than Lake Charles soils. Leton soils are in depressional areas. Vamont soils are in positions similar to those of Lake Charles soils.

The soils in this map unit are used mainly as cropland and pastureland, to which most of these soils are well suited. The main crops are rice, grain sorghum, and soybeans. A few areas are used as hayland and rangeland. A surface drainage system is desirable for increased yields and better grazing distribution.

Urban use is expanding across many areas of this map unit. Soil wetness, clayey texture, and high shrink-swell potential are the main limitations for urban use.

3. Bernard-Verland

Somewhat poorly drained, very slowly permeable soils that have a loamy surface layer and a clayey subsoil

This map unit makes up about 12 percent of the land area of the county. It is about 47 percent Bernard soils, 31 percent Verland soils, and 22 percent other soils.

The soils in this map unit have slopes that are about 0.2 percent. The landscape is a broad, smooth, plane surface. Bernard and Verland soils are in similar positions on the landscape.

Typically, Bernard soils have a surface layer that is slightly acid, very dark gray clay loam about 10 inches thick. The upper part of the subsoil, to a depth of 18 inches, is slightly acid, very dark gray clay. The next layer, to a depth of 40 inches, is neutral, dark gray clay. The lower part to a depth of 65 inches is mildly alkaline, gray and light gray clay.

Typically, Verland soils have a surface layer that is slightly acid, dark gray silty clay loam about 6 inches thick. The upper part of the subsoil, to a depth of 30 inches, is medium acid, gray clay. The middle part, to a depth of 52 inches, is midly alkaline, light gray clay. The lower part to a depth of 60 inches is moderately alkaline, light gray clay.

The minor soils included in this map unit are Bacliff, Edna, Kemah, Lake Charles, Leton, Mocarey, and Stowell soils. Bacliff and Lake Charles soils are in slightly lower positions on the landscape than Bernard and Verland soils, Edna and Mocarey soils are in the slightly higher positions. Leton soils are in depressional areas. Kemah and Stowell soils are on low ridges.

The soils in this map unit are used mainly as cropland and pastureland, to which they are well suited. A few areas are used as hayland and rangeland. Soil wetness is the main limitation. A surface drainage system is desirable for increased yields and better grazing distribution.

Urban use is expanding across many areas of this map unit. Soil wetness and high shrink-swell potential are the main limitations for urban use.

4. Kemah-Edna-Leton

Somewhat poorly drained or poorly drained, slowly permeable or very slowly permeable soils that have a loamy surface layer and a clayey to loamy subsoil

This map unit makes up about 10 percent of the land area of the county. It is about 31 percent Kemah soils, 21 percent Edna soils, 20 percent Leton soils, and 28 percent other soils.

The soils in this map unit have slopes that are about 0.3 percent. The landscape has many old, partly filled stream meanders and shallow depressions. Kemah soils are mainly on the high parts of the landscape or on slopes along the side of bayous or creeks. Edna soils are mainly on the low, smooth parts of the landscape.

Leton soils are in the old stream meanders and depressional areas.

Kemah soils are somewhat poorly drained and are very slowly permeable. Typically, the surface layer is medium acid, dark grayish brown silt loam about 10 inches thick. The subsurface layer, to a depth of 15 inches, is strongly acid, grayish brown loam. The upper part of the subsoil, to a depth of 24 inches, is medium acid, mottled dark gray and grayish brown clay. The middle part, to a depth of 38 inches, is medium acid, grayish brown clay. The lower part to a depth of 60 inches is neutral, grayish brown sandy clay loam.

Edna soils are poorly drained and are very slowly permeable. Typically, the surface layer is slightly acid, dark gray fine sandy loam about 8 inches thick. The upper part of the subsoil, to a depth of 26 inches, is medium acid, gray clay. The middle part, to a depth of 45 inches, is neutral, light gray clay. The lower part to a depth of 60 inches is moderately alkaline, light brownish gray clay.

Leton soils are poorly drained and are slowly permeable. Typically, the surface layer is neutral, dark gray loam about 5 inches thick. The subsurface layer, to a depth of 12 inches, is neutral, gray loam. The upper part of the subsoil, to a depth of 26 inches, is neutral, gray clay loam mixed with some gray loam. The lower part to a depth of 60 inches is moderately alkaline, light gray clay loam.

The minor soils included in this map unit are Aris, Bernard, and Lake Charles soils. Aris soils are in similar positions as Kemah soils on the higher parts of the landscape. Bernard and Lake Charles soils are in slightly lower positions on the landscape than Edna soils.

The soils in this map unit are used mainly as pastureland and cropland. Also, some acreage is used as hayland and rangeland. Crops are mainly rice and soybeans. A small amount of vegetables are grown for local consumption. Soil wetness and uneven surfaces are the main limitations. A surface drainage system is desirable for increased yields and better grazing distribution. Some areas have been leveled, but the depressional soils in these areas generally remain wet.

Urban use is expanding across many areas of this map unit. Soil wetness and high shrink-swell potential are the main limitations for urban use.

5. Bernard-Edna

Somewhat poorly drained or poorly drained, very slowly permeable soils that have a loamy surface layer and a clayey subsoil

This map unit makes up about 7 percent of the land area of the county. It is about 67 percent Bernard soils, 17 percent Edna soils, and 16 percent other soils.

The soils in this map unit have slopes that are about 0.2 percent. The landscape is a broad, smooth, plane surface. Bernard soils are on the slightly lower, smoother parts of the landscape. Edna soils are in the slightly higher areas, and, in places, they are on the low mounds.

Bernard soils are somewhat poorly drained. Typically, the surface layer is slightly acid, very dark gray clay loam about 10 inches thick. The upper part of the subsoil, to a depth of 18 inches, is slightly acid, very dark gray clay. The next layer, to a depth of 40 inches, is neutral, dark gray clay. The lower part to a depth of about 65 inches is mildly alkaline, gray and light gray clay.

Edna soils are poorly drained. Typically, the surface layer is slightly acid, dark gray fine sandy loam about 8 inches thick. The upper part of the subsoil, to a depth of 26 inches, is medium acid, gray clay. The middle part, to a depth of 45 inches, is neutral, light gray clay. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light brownish gray clay.

The minor soils included in this map unit are Aris, Bacliff, Kemah, and Lake Charles soils. Aris and Kemah soils are in slightly higher positions on the landscape than Edna soils. Bacliff and Lake Charles soils are in slightly lower positions than Bernard soils.

The soils in this map unit are used mainly as cropland and pastureland, to which most of these soils are well suited. A few areas are used as hayland and rangeland. Soil wetness is the main limitation. A surface drainage system is desirable for increased yields and better grazing distribution.

Soil wetness and high shrink-swell potential are the main limitations for urban use.

Deep, Saline Soils of the Marshland

The three general soil map units in this group make up about 25 percent of the land area of Galveston County. The major soils are in the Francitas, Ijam, Narta, Placedo, Tracosa, and Veston series. These soils are in broad, nearly level areas near the bays and are affected by salt and tides from the Gulf of Mexico. They are somewhat poorly drained to very poorly drained and have a high water table that ranges from 1 foot above the soil surface to 1 foot or 2 feet below. The soils in these map units are loamy and clayey and are slowly permeable or very slowly permeable.

Most of these soils are used as rangeland and as habitat for wildlife. They are poorly suited to or not suited to use as cropland or pastureland.

The main limitations for urban use are wetness and salinity. In addition, the frequent flooding of some of the soils in this group is a hazard.

6. Placedo-Tracosa-Veston

Very poorly drained or poorly drained, very slowly permeable or slowly permeable soils that are clayey or loamy throughout

This map unit makes up about 16 percent of the land area of the county. It is about 24 percent Placedo soils,

21 percent Tracosa soils, 13 percent Veston soils, and 42 percent other soils.

The soils in this map unit have slopes that average about 0.1 percent. The landscape has many bodies of brackish water, bayous, and coves. This map unit is on the mainland along the bay and on the bay side of Galveston Island and Bolivar Peninsula. Placedo soils are high enough on the landscape that they are only flooded by storm tides or by other tides that are unusually high. Tracosa soils are flooded by daily tides. Veston soils have a slightly undulating surface; and even though all areas of these soils are flooded by storm tides, some areas are flooded more often than others.

Placedo soils are very poorly drained and are very slowly permeable. Typically, the surface layer and upper part of the underlying material of these soils, to a depth of about 36 inches are clay. They are dark gray in the upper part and grade to gray and light gray in the lower part. The lower part of the underlying material to a depth of 60 inches is light gray sandy clay. These soils are strongly saline and moderately alkaline throughout.

Tracosa soils are very poorly drained and are very slowly permeable. Typically, the surface layer is dark gray mucky clay to a depth of about 12 inches. The underlying layer extends to a depth of 60 inches. It is dark gray clay in the upper part, gray clay in the middle part, and light gray clay in the lower part. These soils are strongly saline and moderately alkaline throughout.

Veston soils are poorly drained and are slowly permeable. Typically, the surface layer is moderately saline, dark gray loam about 13 inches thick. The underlying material, to a depth of about 60 inches, is moderately saline, gray, stratified loam and clay loam. The next layer to a depth of 68 inches is moderately saline, gray sandy loam. These soils are mildly alkaline in the surface layer and upper part of the underlying material and moderately alkaline in the lower part of the underlying material.

The minor soils included in this map unit are Caplen, Follet, Harris, Karankawa, Ijam, Sievers, and Tatlum soils. Caplen, Follet, Karankawa, and Tatlum soils are in similar positions on the landscape as Tracosa soils. Harris soils are in similar positions as Placedo soils. Ijam and Sievers soils are in high positions associated with dredged deposits along canals.

The soils in this map unit are used mainly as habitat for wildlife and as rangeland. In most areas, these soils produce high yields of native grasses; however, because of soil wetness and poor access to livestock, these soils are difficult to manage to their grazing potential. This map unit is important for migratory waterfowl.

For most urban uses, the main limitations are wetness, salinity, and the high shrink-swell potential of some of the soils. Furthermore, frequent flooding is a hazard.

7. Narta-Francitas

Somewhat poorly drained or poorly drained, very slowly permeable soils that have a loamy or clayey surface layer and a clayey subsoil

This map unit makes up about 5 percent of the land area of the county. It is about 82 percent Narta soils, 11 percent Francitas soils, and 7 percent other soils.

The soils in this map unit have slopes that are about 0.3 percent. The landscape is a broad, smooth, plane surface except for a few ill-defined bayous or drainageways. Narta and Francitas soils are in similar positions on the landscape.

Narta soils are somewhat poorly drained. Typically, the surface layer is moderately saline, mildly alkaline, dark gray fine sandy loam about 9 inches thick. The upper part of the subsoil, to a depth of 14 inches, is very dark gray clay. The lower part to a depth of 60 inches is gray and light gray clay. The subsoil is moderately alkaline, moderately saline throughout.

Francitas soils are poorly drained. Typically, the upper part of the surface layer is slightly saline, very dark gray clay about 18 inches thick. The lower part, to a depth of 36 inches, is moderately saline, dark gray clay. The subsoil extends to a depth of 73 inches. The upper part is gray clay, the middle part is light brownish gray clay, and the lower part is mottled light gray and brownish yellow clay. The subsoil is moderately saline throughout. These soils are moderately alkaline throughout.

The minor soils included in this map unit are Aris, Bernard, Caplen, Follet, Lake Charles, Placedo, and Tracosa soils. Aris, Bernard, and Lake Charles soils are in high positions on the landscape. These soils are not saline. Caplen, Follet, Placedo, and Tracosa soils are in low positions on the landscape. They are saline and are frequently flooded.

The soils in this map unit are used mainly as rangeland and as habitat for wildlife. Range forage yields are high. In most areas, these soils are not suited to cropland because of salinity.

Wetness, salinity, and the shrink-swell potential of the soils are the main limitations for most urban uses.

8. Ijam

Poorly drained, very slowly permeable soils that are clayey throughout

This map unit makes up about 4 percent of the land area of the county. It is about 80 percent Ijam soils and 20 percent other soils.

The soils in this map unit have slopes of about one percent but range from 0 to 8 percent. The landscape is nearly level to moderately sloping. These soils are along the side of canals and bays. They consist of saline, clayey sediments dredged from canals and bays.

Typically, Ijam soils have a surface layer that is dark grayish brown clay about 10 inches thick. The underlying material, to depth of 35 inches, is dark gray clay. The next layer, to a depth of 56 inches, is gray clay. The lower part to a depth of 61 inches is bluish gray stratified

sandy clay loam and sand. These soils are moderately alkaline to neutral. They are moderately saline throughout.

The minor soils included in this map unit are Bernard, Francitas, Lake Charles, Narta, and Sievers soils. Bernard, Francitas, Lake Charles, and Narta soils occur in areas where the spoil material was not placed on top of the original soil surface; therefore, these soils are in slightly lower positions on the landscape than Ijam soils. Sievers soils are in similar positions as Ijam soils.

The soils in this map unit are used mainly for urban development and as rangeland. It is not suited to use as cropland.

For most urban uses, the main limitations are wetness, salinity, and the shrink-swell potential of the soils. Flooding, which is caused by storm tides, is a hazard.

Deep, Nonsaline Soils of the Barrier Island

This one general soil map unit makes up about 14 percent of Galveston County. The major soils are in the Galveston and Mustang series. These soils are in nearly level to gently undulating areas on Galveston Island and Bolivar Peninsula. The landscape consists of beaches fronting the Gulf of Mexico, the barrier sand dunes, and the nearly level, wet sands behind the dunes. Most of the soils are nonsaline, but salt spray affects the vegetation. Hurricanes and other storms flood most of these areas. These soils are poorly drained and somewhat excessively drained. They have a high water table within 1 foot of the surface in the wet areas and to a depth of about 5 feet in the dunes. These soils are sandy and rapidly permeable.

These soils are generally not suited to crop production, but a few acres are planted to specialty crops. Some areas are used as rangeland.

A large acreage has been developed for recreation and urban use. The main limitations for urban use are wetness and wind erosion. In addition, occasional flooding is a hazard.

9. Mustang-Galveston

Poorly drained to somewhat excessively drained, rapidly permeable soils that are sandy throughout

This map unit makes up about 14 percent of the land area of the county. It is about 50 percent Mustang soils, 20 percent Galveston soils, and 30 percent other soils.

The soils in this map unit have slopes of 0 to 5 percent. The landscape is typified by gently undulating dunes flanked by beaches fronting the Gulf of Mexico and by nearly level, wet sand behind the dunes. Mustang soils are in the smooth, wet areas. Galveston soils are on the dunes.

Mustang soils are poorly drained. Typically, the surface layer is mildly alkaline, dark gray fine sand about 3 inches thick. The upper part of the underlying material, to a depth of 7 inches, is moderately alkaline, grayish brown fine sand. The lower part to a depth of 60 inches is moderately alkaline, gray fine sand. These soils are nonsaline throughout.

Galveston soils are somewhat excessively drained. Typically, the surface layer is neutral, grayish brown fine sand about 6 inches thick. The upper part of the underlying material, to a depth of 12 inches, is mildly alkaline, pale brown fine sand. The middle part, to a depth of 30 inches, is mildly alkaline, dark grayish brown fine sand. The lower part to a depth of 60 inches is mildly alkaline, very pale brown fine sand. These soils are nonsaline throughout.

The minor soils included in this map unit are Ijam, Nass, Sabine, and Veston soils. Ijam soils are in areas where dredged materials have been placed. Nass soils are in depressional areas and in other low, concave positions on the landscape. Sabine soils are in similar positions on the landscape as Galveston soils. Veston soils are in similar positions as Mustang soils.

The soils in this map unit are used mainly for recreation and for urban development. The city of Galveston is in this map unit. Many beach homes and summer cottages are in the area. Some areas are used as rangeland and as habitat for wildlife.

The main limitations to use of these soils for urban use are wetness and wind erosion. In addition, occasional flooding, which is caused by storms, is a hazard.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Lake Charles clay, 0 to 1 percent slopes, is one of several phases in the Lake Charles series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Morey-Leton complex is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Beaches are an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

AaB—Arents, clayey, 0 to 3 percent slopes. This is a nearly level to gently sloping, somewhat poorly drained, nonsaline, clayey soil. It consists of clayey materials dredged from bays, canals, ditches, and other waterways. The slopes average about 2 percent. The mapped areas range from 10 acres to a few hundred acres.

Arents, clayey, is a soil that is randomly mixed with different layers of dredged materials, is about 2 to 6 feet thick, and is placed on top of other soils. These materials are placed mostly on top of Bernard, Lake Charles, and Mocarey soils.

Arents is very dark gray, dark gray, light gray, very dark grayish brown, and dark grayish brown clay. Reaction is neutral to moderately alkaline.

Included with this soil in mapping are some areas of soils that are loamy. The included soils make up less than 25 percent of the map unit.

The permeability is very slow. The surface runoff is slow. Some areas are flooded by storm tides or from upland floodwater. A high water table is within 2 feet of the surface during most of the winter.

Arents is used mainly for urban and industrial development.

Arents is well suited to pasture grasses. Because it has low natural fertility, applications of fertilizers are needed to produce high yields. A well planned grazing management system also is needed to increase forage yields and quality.

This soil is capable of producing high yields of good native grasses when properly managed. However, in areas where dredged material has just been added, the plant community may not become stable for many years.

For most urban uses, the major limitations are wetness, clayey texture, and high shrink-swell potential of the soil.

Arents is in capability subclass IIIw. It is in the Blackland range site.

Ar—Aris fine sandy loam. This is a nearly level, somewhat poorly drained, nonsaline, loamy soil that has a clayey subsoil. It is on the uplands. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 20 acres to a few hundred acres.

Typically, this soil has a surface layer that is slightly acid, dark grayish brown fine sandy loam about 10 inches thick. The subsurface layer, to a depth of 20 inches, is slightly acid, grayish brown fine sandy loam. The upper part of the subsoil, to a depth of 32 inches, is grayish brown sandy clay loam mixed with about 25 percent grayish brown fine sandy loam. The middle part, to a depth of 49 inches, is light brownish gray clay loam. The lower part to a depth of 62 inches is light gray clay. Reaction is neutral throughout the subsoil.

Included with this soil in mapping are small areas of Bernard, Edna, Kemah, Leton, Mocarey, and Verland soils. Bernard, Edna, and Verland soils are in lower positions on the landscape than Aris soil. Leton soils are in depressional areas. Kemah, and Mocarey soils are in similar positions on the landscape as Aris soil. Also included is a soil that is similar to Aris soil, is in similar positions on the landscape, and has concretions of calcium carbonate in the upper part of the subsoil. The included soils make up less than 30 percent of the map unit.

This soil is very slowly permeable. The surface runoff is slow. This soil is rarely flooded. A high water table is within 2 feet of the surface during most of the winter.

This Aris soil is mainly used as pastureland. In a few areas, it is used for soybeans and grain sorghum. Some small vegetable farms are in this map unit.

This soil is moderately suited to crops. It is well suited to rice production because it is very slowly permeable and is easy to level. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. This soil tends to be droughty during prolonged dry periods in the summer. It also becomes hard during these dry periods. If dryland crops are grown, plowing, planting, and cultivating should be done in a timely manner when the soil is moist and friable. Incorporating crop residue in the surface layer helps maintain good tilth. In areas where land leveling is needed, the soil should be checked before leveling to ensure that it does not have a highly calcareous subsoil that will be near the surface after leveling. Plants and fertilizer respond differently in these calcareous areas than they do in surrounding areas. A well planned fertilizer program is essential to obtain desirable yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed. The soil tends to become droughty during prolonged dry periods in the summer.

For most urban uses, the main limitations are wetness and high shrink-swell potential of the soil.

This Aris soil is in capability subclass IIIw. It is in the Loamy Prairie range site.

Ba—Bacliff clay. This is a nearly level, poorly drained, nonsaline, clayey soil that has a clayey subsoil. It is on broad uplands. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 5 acres to about 3,000 acres.

Typically, this soil has a surface layer that is about 35 inches thick. It is medium acid, dark gray clay in the upper 9 inches. The lower part of the surface layer is neutral, gray clay. The subsoil to a depth of 63 inches is light gray clay. Reaction is neutral in the upper part of the subsoil and moderately alkaline in the lower part.

Included with this soil in mapping are small areas of Bernard, Edna, Lake Charles, Vamont, and Verland soils. Bernard, Edna, Lake Charles, and Verland soils are in slightly higher positions on the landscape than Bacliff soil, and Vamont soils are in similar positions. Also included is an unnamed soil that has a darker surface layer and a browner subsoil than Bacliff soil. The included soils make up less than 10 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded. A high water table is within 1 foot of the surface during most of the winter.

This Bacliff soil is used as cropland, pastureland, or rangeland. The main crops include rice and soybeans. Some grain sorghum also is grown.

This soil is moderately suited to crops. It is well suited to rice production because it is naturally level and requires little smoothing to flood it evenly. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. Because the soil has a clayey surface layer, it is difficult to till when dry; and when dry, it develops large cracks. In this condition, water readily enters the soil; and as the soil becomes moist, the cracks seal and water movement through the soil is very slow. Incorporating crop residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness, clayey texture, and high shrink-swell potential of the soil.

This Bacliff soil is in capability subclass IIIw. It is in the Blackland range site.

Bb—Beaches. This map unit is sandy, nearly level to undulating, and nonsaline to extremely saline. It is on the land area immediately adjacent to the Gulf of Mexico from the mean tide line to the back of the coastal dunes (fig. 1). The surface is plane in front of the dunes and is undulating within the dune area. The slopes range from as low as 0.2 percent in the area in front of the dunes to as high as about 15 percent on the side slopes of a few of the dunes. The mapped areas are long and narrow and range from 10 acres to about 100 acres.

Beaches consist mainly of sandy marine deposits and varied amounts of shell fragments. It is reworked by both the tide and wind. It is barren. The lower areas are inundated daily by high tides. The higher areas are inundated regularly by spring tides. A high water table is at or near the surface throughout the year.

Included with Beaches in mapping are small areas of Galveston and Mustang soils. These vegetated areas are in the coastal dunes.

This map unit is used extensively as recreation land because it is immediately adjacent to the Gulf of Mexico.

This map unit has not been assigned to a capability subclass or to a range site.

Be—Bernard clay loam. This is a nearly level, somewhat poorly drained, nonsaline, loamy soil that has a clayey subsoil. It is on the uplands. The slopes average about 0.2 percent. The mapped areas are

Figure 1.—This map unit is along the Gulf of Mexico and is mainly used for recreation.

irregular in shape and range from 5 acres to about 1,000 acres.

Typically, this soil has a surface layer that is slightly acid, very dark gray clay loam about 10 inches thick. The upper part of the subsoil, to a depth of 18 inches, is slightly acid, very dark gray clay. The next layer, to a depth of 40 inches, is neutral, dark gray clay. The next layer, to a depth of 60 inches, is mildly alkaline, gray clay. The lower part to a depth of 65 inches is mildly alkaline, light gray clay.

Included with this soil in mapping are small areas of Bacliff, Edna, Lake Charles, Mocarey, Morey, Vamont, and Verland soils. Bacliff, Lake Charles, and Vamont soils are in slightly lower positions on the landscape than Bernard soil; Edna, Mocarey, and Morey soils are in slightly higher positions; and Verland soils are in similar positions. The included soils make up less than 15 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded. A high water table is within 2 feet of the surface during most of the winter.

This Bernard soil is used as cropland, pastureland, or rangeland. The main crops include rice and soybeans. Some grain sorghum also is grown.

This soil is well suited to crops. It is also well suited to rice production because it is very slowly permeable and level, and it does not require much smoothing to flood evenly. A well designed surface water management system that includes proper direction, drainage, leveling, and irrigation water management is an important factor for crop production. Incorporating crop residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality. This soil is also used for native hay meadows.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness, clayey texture, and high shrink-swell potential of the soil.

This Bernard soil is in capability subclass IIw. It is in the Blackland range site.

Bn—Bernard-Edna complex. This complex consists of nearly level, somewhat poorly drained and poorly drained, nonsaline, loamy soils that have a clayey subsoil. These soils are on the uplands. Although the overall surface is plane, it has 15 to 40 percent mounds. In unleveled areas, the mounds are about 0.5 of a foot high and 10 to 15 feet across. The overall slopes average about 0.2 percent. The mapped areas are irregular in shape and range from 5 acres to several hundred acres.

Bernard soil makes up 40 to 60 percent of the map unit, and Edna soil makes up about 20 to 40 percent. Bernard soil is typically in the intermound areas. This soil is somewhat poorly drained. Edna soil is typically on the circular mounds or knolls. This soil is poorly drained. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, in unleveled areas, Bernard soil has a surface layer that is very dark gray clay loam about 10 inches thick. The subsoil extends to a depth of 60 inches. It is slightly acid, very dark gray clay in the upper part of the subsoil and mildly alkaline, grayish brown clay in the lower part.

Typically, in unleveled areas, the Edna soil has a surface layer that is slightly acid, dark gray fine sandy loam about 8 inches thick. The subsoil extends to a depth of 60 inches. It is gray clay. Reaction is slightly acid in the upper part of the subsoil and neutral in the lower part.

Included with these soils in mapping are areas of Aris, Kemah, Lake Charles, Leton, Morey, and Verland soils. Aris, Kemah, and Morey soils generally are on mounds and knolls. Lake Charles and Verland soils are in the intermound areas. Leton soils are in enclosed depressions. In most places, the surface layer of the mounds has been partly or totally removed by leveling.

These soils are very slowly permeable. The surface runoff is very slow. The soils in this complex are rarely flooded. Edna soil tends to be droughty in the summer during dry periods, and it also becomes hard during these dry periods. If dryland crops are grown, plowing, planting, and cultivating should be done in a timely manner when the soil is moist and friable. In unleveled or partly leveled areas, a perched water table is within 1.5 feet of the surface during most of the winter in the intermound areas and is within 2 feet of the surface on the mounds. In leveled areas, a perched water table is within 1.5 feet of the surface during most of the winter.

The soils in this complex are mainly used as cropland and pastureland. The main crops are rice and soybeans. Some grain sorghum also is grown.

These soils are well suited to crops. They are also well suited to rice production because these soils are very slowly permeable and are relatively easy to level. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor for crop production. In some places, in areas where the mounds are located, the soil becomes too salty after leveling for good crop production. When properly managed, these sites can become more productive in a few years. A well planned fertilizer program is essential to obtain high yields.

These soils are well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing

management program that includes fertilization increases forage production and improves quality.

The soils in this complex are capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness and shrink-swell potential of the soils.

The soils in this complex are in capability subclass IIIw. Bernard soil is in the Blackland range site. Edna soil is in the Claypan Prairie range site.

Bu—Bernard-Urban land complex. This complex consists of a nearly level, somewhat poorly drained, nonsaline, loamy soil that has a clayey subsoil and Urban land. The slopes average about 0.2 percent. The mapped areas are irregular in shape and range from 5 acres to a few hundred acres.

Bernard soil makes up 30 to 60 percent of the map unit. Urban land makes up 30 to 50 percent. Bernard soil is in open lots, yards, and other open areas. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Bernard soil has a surface layer that is very dark gray clay loam about 10 inches thick. The subsoil extends to a depth of 60 inches. It is medium acid, very dark gray clay in the upper part of the subsoil and is moderately alkaline, gray clay in the lower part.

Urban land consists of areas that have been altered or obscured by buildings or other urban structures, making classification of the soils impractical. Typically, these structures are single-and multiple-unit dwellings, garages, sidewalks, driveways, streets, schools, churches, shopping centers, office buildings, and parking lots. Areas of the Bernard soil and areas of other soils that have been altered by cutting, grading, and filling make up some of the Urban land in this map unit. In some places, the soil has not been altered but is covered by 6 to 24 inches of fill material.

Included in mapping are areas of Aris, Bacliff, Edna, Kemah, Lake Charles, Mocarey, and Morey soils.

The soils in this complex are very slowly permeable. The surface runoff is very slow. These soils are rarely flooded. A high water table is within 2 feet of the surface during the winter.

For most urban uses, the main limitations are wetness, clayey texture, and high shrink-swell potential of the soils.

The soils in this complex have not been assigned to a capability subclass or to a range site.

Ca—Caplen mucky silty clay loam. This is a nearly level, very poorly drained, saline, loamy soil. It is in the coastal marshes. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 20 acres to several hundred acres.

Typically, this soil has a surface layer that is moderately alkaline, dark gray mucky silty clay loam about 10 inches thick. The upper part of the underlying material, to a depth of 16 inches, is moderately alkaline, dark gray mucky silty clay loam. The middle part, to a depth of 35 inches, is neutral, dark gray to gray clay. The lower part to a depth of 60 inches is moderately alkaline, light gray clay loam. This soil is strongly saline throughout.

Included with this soil in mapping are small areas of Follet, Placedo, Tatlum, and Tracosa soils. Placedo soils are in slightly higher positions on the landscape than Caplen soils. Follet, Tatlum, and Tracosa soils are in slightly lower positions. Also included is a soil that is similar to Caplen soil but is more firm within a depth of 40 inches. The included soils make up less than 35 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. A permanent high water table allows very little water movement through the soil. This soil remains saturated throughout most of the year. It is covered with 2 to 12 inches of tidal water at some time each day. This soil is frequently flooded by spring tides, storm tides, and heavy rains. It is generally so soft that it can not support the weight of man, livestock, or equipment.

This Caplen soil is mainly used as habitat for wildlife. It is not suited to crop production or pastureland because of wetness, flooding, and salinity. This soil is used by nongame wetland wildlife and is an important part of the marine estuarine system.

This soil is capable of producing high yields of range grasses, but it is generally not suited to livestock grazing because the soil can not support the weight of livestock.

For most urban uses, the main limitations are low strength, wetness, and salinity. Flooding is a hazard.

This Caplen soil is in capability subclass VIIIw. It is in the Deep Marsh range site.

Ct—Caplen-Tracosa complex. This complex consists of nearly level, very poorly drained, saline, clayey soils that have a clayey subsoil. These soils are in the marshes. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 10 acres to a few hundred acres.

Caplen soil makes up 40 to 80 percent of the map unit, and Tracosa soil makes up 20 to 45 percent. Caplen soil generally is in the slightly higher areas. Tracosa soil generally is in slightly lower areas. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale for the maps in the back of this publication.

Typically, Caplen soil has a surface layer that is gray mucky silty clay loam about 14 inches thick. The underlying material to a depth of 42 inches is gray clay. This soil is moderately saline and moderately alkaline throughout.

Typically, Tracosa soil is clay to a depth of 60 inches. The surface layer and upper part of the underlying material is dark gray, and the lower part of the underlying material is gray. This soil is strongly saline and moderately alkaline throughout.

Included in mapping are some small areas of Follet and Tatlum soils. These soils are in similar positions on the landscape as Tracosa soil. Also included is a soil that is similar to Caplen soil but is more firm within 40 inches of the surface.

The soils in this complex are very slowly permeable. The surface runoff is very slow. These soils remain saturated throughout the year. They are covered with 2 to 12 inches of tidal water at some time during the day. These soils are frequently flooded by storm tides and heavy rains. Caplen soil is so fluid that it generally can not support the weight of man, livestock, or equipment.

The soils in this complex are mainly used as habitat for wildlife. These soils are not suited to crop production or pastureland because of wetness, flooding, and salinity. This complex is used extensively by nongame wetland wildlife and is ah important part of the marine estuarine system.

Range forage yields are high, but the soils in this map unit are not used as rangeland because they can not support the weight of livestock.

For most urban uses, the main limitations are low strength, wetness, clayey texture, and salinity. Flooding is a hazard.

The soils in this complex are in capability subclass VIIIw. Caplen soil is in the Deep Marsh range site. Tracosa soil is in the Tidal Flat range site.

Ed—Edna fine sandy loam. This is a nearly level, poorly drained, nonsaline, loamy soil that has a clayey subsoil. It is on the uplands. The slopes average about 0.2 percent. The mapped areas are irregular in shape and range from 5 acres to several hundred acres.

Typically, this soil has a surface layer that is slightly acid, dark gray fine sandy loam about 8 inches thick. The upper part of the subsoil, to a depth of 26 inches, is medium acid, gray clay. The middle part, to a depth of 45 inches, is neutral, light gray clay. The lower part to a depth of 60 inches is moderately alkaline, light brownish gray clay.

Included with this soil in mapping are small areas of Aris, Bacliff, Bernard, Kemah, Leton, and Verland soils. Aris and Kemah soils are in slightly higher positions on the landscape than Edna soil. Bacliff, Bernard, and Verland soils are in slightly lower positions. Leton soils are in depressional areas. The included soils make up less than 15 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded. The high water table is within 1.5 feet of the surface during most of the winter. Although the root zone is deep, the dense, clayey subsoil tends to impede the movement of air, water, and roots.

This Edna soil is used as cropland, pastureland, or rangeland. The main crops grown include rice and soybeans. Some grain sorghum is grown.

This soil is moderately suited to crops. It is well suited to rice production because it is very slowly permeable and is easy to level. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. This soil tends to be droughty during prolonged dry periods in the summer. It also becomes hard during these dry periods. If dryland crops are grown, plowing, planting, and cultivating should be done in a timely manner when the soil is moist and friable. Incorporating crop residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality. During dry periods in the summer, plants on this soil show drought stress earlier than on other soils.

This soil is capable of producing medium yields of native range grasses when properly managed. The reduced yields are most noticeable during the summer.

For most urban uses, the main limitations are wetness and high shrink-swell potential of the soil.

This Edna soil is in capability subclass IIIw. It is in the Claypan Prairie range site.

Es—Edna-Aris complex. This complex consists of nearly level, somewhat poorly drained and poorly drained, nonsaline, loamy soils that have a clayey subsoil. These soils are on the uplands. This map unit is generally associated with old stream meander systems. Although the overall surface is plane, it has many distinctive knolls and pimple mounds. In unleveled areas, the mounds are about 1.5 feet high and 15 to 30 feet across. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 10 acres to a few hundred acres.

Edna soil makes up 45 to 70 percent of the map unit. Aris soil makes up 15 to 40 percent. Edna soil is in the intermound areas. This soil is poorly drained. Aris soil is on the convex knolls and pimple mounds. It is somewhat poorly drained. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, in unleveled areas, Edna soil has a surface layer that is medium acid, dark gray fine sandy loam about 8 inches thick. The upper part of the subsoil, to a depth of 23 inches, is slightly acid, gray clay. The lower

part to a depth of 60 inches is mildly alkaline, light brownish gray clay.

Typically, in unleveled areas, Aris soil has a surface layer that is slightly acid, dark grayish brown fine sandy loam about 10 inches thick. The subsurface layer, to a depth of 21 inches, is slightly acid, grayish brown fine sandy loam. The upper part of the subsoil, to a depth of 32 inches, is slightly acid, grayish brown clay loam that is mixed with about 20 percent grayish brown fine sandy loam. The lower part to a depth of 60 inches is mildly alkaline, gray clay. In areas that have been leveled, much of the surface layer of Aris soil has been removed and added to the surface of Edna soil.

Included with these soils in mapping are areas of Bernard, Cieno, Kemah, Leton, and Verland soils.

The soils in this complex are very slowly permeable. The surface runoff is very slow. These soils are rarely flooded. In unleveled areas, a perched water table is within 1 foot of the surface during most of the winter in the intermound areas and is within 1.5 feet of the surface in the mounds areas. In leveled areas, a perched water table is within 1 foot of the surface during most of the winter.

The soils in this complex are mainly used as rangeland or pastureland. Some areas are used as cropland. The main crops are rice and soybeans. Some grain sorghum also is grown.

These soils are moderately suited to crops. They are also moderately suited to rice production because leveling is difficult. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor for crop production. After some areas are leveled, the subsoil beneath the former mound areas can be so near the surface that most of the plant root zone is salty and moderately alkaline. This causes plants and fertilizer to respond differently than in surrounding areas and reduces yields, especially on soil used for rice production. The soils in this map unit tend to be droughty during prolonged dry periods in the summer. They also become hard during these dry periods. If dryland crops are grown, plowing, planting, and cultivating should be done in a timely manner when the soil is moist and friable. Incorporating soil residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

These soils are well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. These soils tend to be droughty during prolonged dry periods in the summer. A grazing management program that includes fertilization increases forage production and improves quality.

These soils are capable of producing high yields of native range grasses when properly managed. Forage production is reduced during prolonged dry periods in the summer because of droughtiness.

For most urban uses, the main limitations are wetness, high shrink-swell potential, and the uneven topography of the soils.

The soils in this complex are in capability subclass IIIw. Edna soil is in the Claypan Prairie range site. Aris soil is in the Loamy Prairie range site.

Fo—Follet loam. This is a nearly level, very poorly drained, saline, loamy soil that has a loamy subsoil. It is in broad, tidal marshes. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 20 acres to several hundred acres.

Typically, this soil has a surface layer that is mildly alkaline, gray loam about 8 inches thick. The upper part of the underlying material, to a depth of 40 inches, is moderately alkaline, light gray loam. The lower part to a depth of 60 inches is moderately alkaline, light gray clay loam.

Included with this soil in mapping are small areas of Karankawa; Mustang fine sand, saline; Tatlum; Tracosa; and Veston soils. Karankawa, Tatlum, and Tracosa soils are in similar positions on the landscape as Follet soil. Mustang fine sand, saline, soils and Veston soils are in higher positions. The included soils make up less than 20 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. The high water table allows for very little water movement through the soil. This soil remains saturated throughout the year. It is covered daily with 2 to 12 inches of water during high tide. This soil is frequently flooded by spring tides, storm tides, and rainstorms.

This Follet soil is mainly used as habitat for wildlife. It is not suited to crop production or pastureland because of wetness, flooding, and salinity. This area of Follet soil is used extensively by nongame wetland wildlife and is an important part of the marine estuarine system.

This soil produces fair yields of marsh grasses; however, it is seldom used as rangeland because it is boggy, does not have available freshwater and bedding areas, and is inundated by tides. Management of these areas is difficult.

For most urban uses, the main limitations are wetness, low strength, and salinity. Flooding is a hazard.

This Follet soil is in capability subclass VIIw. It is in the Tidal Flat range site.

Fr—Francitas clay. This is a nearly level, poorly drained, saline, clayey soil that has a clayey subsoil. It is on uplands that are adjacent to coastal marshes. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 10 acres to several hundred acres.

Typically, the soil has a surface layer that is slightly saline, very dark gray clay about 13 inches thick. The next layer, to a depth of 36 inches, is moderately saline, dark gray clay. The upper part of the subsoil, to a depth

of 48 inches, is moderately saline, gray clay. The middle part, to a depth of 60 inches, is moderately saline, light brownish gray clay. The lower part to a depth of 73 inches is mottled light gray and brownish yellow clay. Reaction is moderately alkaline throughout.

Included with this soil in mapping are small areas of Edna, Lake Charles, Narta, and Placedo soils. Edna and Lake Charles soils are in higher positions on the landscape than Francitas soil, Placedo soils are in lower positions, and Narta soils are in similar positions. The included soils make up less than 25 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded by storm tides and upland runoff. A high water table is within 1 foot of the surface during most of the winter.

This Francitas soil is mainly used as rangeland. A few areas have been used as cropland, mainly for rice production, with limited success.

This soil is poorly suited to crops. It is also poorly suited to rice production. To obtain acceptable yields, the soil must be closely managed to prevent salt buildup on the surface and to prevent the soil from becoming too saline or too dry during critical growth stages. If a storm tide inundates this soil, it can become moderately saline for several years. This soil is poorly drained; therefore, a system of field drains should be installed. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. Because the soil has a clayey surface layer, it is difficult to till when dry; and when dry, it develops cracks. In this condition, water readily enters the soil; and as the soil becomes moist, the cracks seal and water movement through the soil is very slow. Incorporating crop residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is poorly suited to pasture grasses. Selecting a proper site and planting grasses adapted to the soil are important because of salinity. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil will produce high yields of marsh range grasses. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be used to maintain plant vigor. This Francitas soil is in pastures in the higher positions in the marsh. These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the main limitations are wetness and salinity. Flooding is a hazard.

This Francitas soil is in capability subclass IVw. It is in the Salty Prairie range site.

GaB—Galveston fine sand, undulating. This is a gently undulating, somewhat excessively drained, nonsaline, sandy soil. It is on old, abandoned beach ridges. The surface is plane to gently undulating. The slopes range from 0.2 to 5 percent. The mapped areas are generally oblong and range from 10 acres to several hundred acres.

Typically, this soil has a surface layer that is neutral, grayish brown fine sand about 6 inches thick. The upper part of the underlying material, to a depth of 12 inches, is pale brown fine sand. The middle part, to a depth of 30 inches, is dark grayish brown fine sand. The lower part of the underlying material to a depth of 60 inches is very pale brown fine sand. Reaction is mildly alkaline in the underlying material.

Included with this soil in mapping are small areas of Mustang, Nass, and Sabine soils. Some mapped areas, such as those in the city of Galveston, are areas where an average of 5 feet of sandy spoil material was added to the original surface layer many years ago. Mustang and Nass soils are in lower positions on the landscape than Galveston soil, and Sabine soils are in similar positions. The included soils make up less than 10 percent of the map unit.

This soil is rapidly permeable above the high water table. The surface runoff is very slow. The high water table is between depths of 3 and 5 feet during most of the winter. This soil is occasionally flooded by storm tides. It is nonsaline most of the year except during prolonged dry periods. Without adequate rainfall, the surface layer can become slightly saline because of salt spray. The salt is readily leached from the soil during rainy periods. This soil is also susceptible to wind erosion if it is left unprotected after being disturbed.

This Galveston soil is used mainly as rangeland. Some acreage is used as pastureland. This soil is not suited to general cropland or pastureland because of plant exposure to salt spray and sandy texture. A few speciality crops and pasture grasses are adapted to this soil.

This soil will produce moderate yields of marsh range grasses when properly managed. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be used to maintain plant vigor. This Galveston soil is in large pastures in the higher positions in the marsh. These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the susceptibility to flooding by storm tides, wind damage by hurricanes, and the susceptibility to wind erosion when the soil is left unprotected for long periods are severe hazards. Because of the proximity of this soil to the beaches of the Gulf of Mexico, it is often used as sites for weekend and summer cottages and for other related urban uses.

This Galveston soil is in capability subclass VIe. It is in the Low Coastal Sand range site.

Gc—Galveston-Nass complex. This complex consists of gently undulating, somewhat excessively drained and poorly drained or very poorly drained, nonsaline and slightly saline, sandy soils. These soils are on a series of old, abandoned beach ridges and in wet swales that parallel the Gulf of Mexico. The slopes range from 0.5 to 4 percent. The mapped areas are irregular in shape and range from 40 acres to about 1,000 acres.

Galveston soil makes up 50 to 80 percent of the map unit. Nass soil makes up 15 to 30 percent. Mustang soil, an included soil in mapping, makes up 5 to 25 percent. Galveston soil is on the upper part of the ridges. It is somewhat excessively drained. Nass soil is in the wet swales. It is poorly drained or very poorly drained. The soils in this map unit are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Galveston soil has a surface layer that is medium acid, brown fine sand about 22 inches thick. The upper part of the underlying material, to a depth of 61 inches, is neutral, pale brown fine sand. The lower part to a depth of 70 inches is medium acid, light gray fine sand. This soil is nonsaline throughout.

Typically, Nass soil has a surface layer that is slightly saline, moderately alkaline, very dark grayish brown very fine sand about 6 inches thick. The underlying material to a depth of 60 inches is moderately saline, moderately alkaline, gray very fine sand.

Included with these soils in mapping are areas of Mustang and Karankawa soils. Also included is a soil that is similar to Nass soil. It is loamy within 40 inches of the surface.

The soils in this complex are rapidly permeable above the high water table. The surface runoff on Galveston soil is very slow. The surface runoff on Nass soil is very slow to ponded. These soils are occasionally flooded by storm tides, and many areas of Nass soil are frequently flooded by heavy rains. Galveston soil has a high water table that is generally at a depth of about 36 to 60 inches on the top of the ridges. On Nass soil, the water table is up to 24 inches above the surface in the center of the wet swales.

The salinity varies according to the position of these soils on the landscape. On the ridges and on the upper part of the side slopes, Galveston soil is nonsaline except during prolonged dry periods. Without adequate rainfall, the surface layer becomes slightly saline because of salt spray. The salt is readily leached from the soil during rainy periods. The lower part of the side slopes is slightly saline to moderately saline most of the year. In the swales, Nass soil is generally moderately saline, but after a rain, it becomes slightly saline. This soil becomes extremely saline during periods of low rainfall in the summer. Typically, a narrow, sparsely vegetated strip is just above the swale. This strip is extremely saline most of the year.

The soils in this complex are mainly used as rangeland. In addition, Nass soil is used as habitat for a variety of wetland wildlife. The soils in this map unit are not suited to general cropland or pastureland because of plant exposure to salt spray. In addition, these soils are not suited to cropland or pastureland because of salinity and high water table on Nass soil and because of the droughtiness of Galveston soil. A few speciality crops and pasture grasses are adapted to Galveston soil; but, because they occur in long, narrow strips, crop production is generally not economical.

The potential range forage yields of the soils in this complex are medium. The plant communities are not the same on Galveston and Nass soils, and the soils are in different range sites. These differences require an understanding of grazing management and plant ecology to consistently obtain high yields. Other concerns in management of Nass soil involve the high water table and the climatically induced plant community changes because of the excessive salinity, which is caused by storm tides, or by prolonged droughts.

Wetness and salinity are the main limitations to use of Nass soil for most urban uses. The susceptibility to flooding of these soils by storm tides and the susceptibility to wind erosion when Galveston soil is left unprotected for long periods are severe hazards. Because of the proximity of these soils to the beaches of the Gulf of Mexico, they are often used as sites for weekend and summer cottages and for other related urban uses.

The soils in this complex are in capability subclass VIw. Galveston soil is in the Low Coastal Sand range site. Nass soil is in the Coastal Swale range site.

Gd—Galveston-Urban land complex. This complex consists of a nearly level, somewhat excessively drained, nonsaline, sandy soil and Urban land. This map unit is in broad, coastal areas. An average of about 5 feet of sandy material, which was dredged from bay and canals, has been added to the original soil surface in these areas. The slopes range from 0.2 to 0.8 percent. The mapped areas are irregular in shape and range from 10 acres to 1,000 acres.

Galveston soil makes up 30 to 50 percent of the map unit. Urban land makes up 20 to 50 percent. Mustang soil which is an included soil, makes up 10 to 30 percent. Galveston soil is in open lots, yards, and other open areas. The soils in this complex are so intricately

mixed that it is not practical to separate them at the scale used for the maps at the back of this publication.

Typically, Galveston soil has a surface layer that is brown fine sand about 20 inches thick. The upper part of the underlying material, to a depth of 35 inches, is light brownish gray fine sand. The lower part to a depth of 60 inches is brown fine sand. This soil is nonsaline and moderately alkaline throughout.

Urban land consists of soils that have been altered or covered by buildings or other urban structures making mapping impractical. Typically, these structures are single and multiple unit dwellings, garages, sidewalks, driveways, streets, schools, churches, shopping centers, office buildings, wharves, warehouses, railroad yards, and parking lots.

Included in mapping are areas of Mustang and Nass soils. Also included are small areas of soils that are similar to Galveston soil that have loamy and clayey layers in the underlying material. Also, some small landfills and excavated areas are included in mapping. Most of this map unit has had an average of 5 feet of sandy dredged material added to the original surface layer in the last 100 years.

The soils in this complex are rapidly permeable above the high water table. The surface runoff is very slow. The high water table is between depths of 2 and 5 feet during most of the winter. It is influenced by the amount of water that is allowed to infiltrate the area and by the water movement restriction that is created by any filling operation. In many areas, these soils are occasionally flooded by storm tides. The soils are nonsaline most of the year except during prolonged dry periods. Without adequate rainfall, the surface layer becomes slightly saline because of salt spray. The salt is readily leached from the soil during rainy periods. This soil is susceptible to wind erosion if it is left unprotected after being disturbed.

For most urban uses, the susceptibility to flooding by storm tides, wind damage by hurricanes, and the susceptibility to wind erosion when the soils are left unprotected for long periods are severe hazards. Because of the proximity of these soils to the beaches of the Gulf of Mexico, they are often used as sites for weekend and summer cottages and for other related urban uses.

The soils in this complex have not been assigned to a capability subclass or to a range site.

Gs—Galveston loamy fine sand, shell substratum. This is a gently undulating, somewhat excessively drained, nonsaline, sandy soil. It is on old, abandoned beach ridges. The slopes range from 0.2 to 1.5 percent. The mapped areas are generally oblong and range from 10 acres to a few hundred acres.

Typically, this soil has a surface layer that is grayish brown loamy fine sand about 15 inches thick. The upper part of the underlying material, to a depth of 21 inches, is brown fine sand that has a few shell fragments. The lower part to a depth of 60 inches is grayish brown sand that has about 40 percent shell fragments. This soil is nonsaline and mildly alkaline throughout.

Included with this soil in mapping are small areas of Galveston, Mustang, and Nass soils. Galveston fine sand is in similar positions on the landscape as Galveston loamy fine sand. Mustang and Nass soils are in lower positions. The included soils make up less than 20 percent of map unit.

This soil is rapidly permeable above the high water table. The surface runoff is very slow. A permanent high water table is between depths of 30 and 50 inches. This soil is occasionally flooded. It is nonsaline most of the year except during prolonged dry periods. Without adequate rainfall, the surface layer becomes slightly saline because of salt spray. The salt is readily leached from the soil during rainy periods. This soil is also susceptible to wind erosion if it is left unprotected after being disturbed.

This Galveston soil is used mainly as rangeland. Some acreage is used as pastureland. This soil is not suited to general cropland and pastureland because of plant exposure to salt spray and sandy texture.

This soil is only suited to special truck crops that can tolerate salt spray. The soil has a low available water capacity and is droughty. It is susceptible to wind erosion. Incorporating crop residue in the surface layer improves the available water capacity and reduces soil loss by wind and water erosion.

This soil is suited to pasture grasses that can withstand salt spray and the droughtiness of the soil. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil will produce moderate yields of native range grasses when properly managed. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be used to maintain plant vigor. This Galveston soil is in large pastures in the higher positions in the marsh. These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the susceptibility to flooding by storm tides, wind damage by hurricanes, and the susceptibility to wind erosion when the soil is left unprotected for long periods are severe hazards. Because of the proximity of this soil to the beaches of the Gulf of Mexico, it is often used as sites for weekend and summer cottages and for other related urban uses.

This Galveston soil is in capability subclass VIe. It is in the Coastal Sand range site.

Ha—Harris clay. This is a nearly level, very poorly drained, saline, clayey soil that has a clayey subsoil. It is in the coastal marshes. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 10 acres to about 300 acres.

Typically, this soil has a surface layer that is very dark gray clay about 13 inches thick. It is neutral and moderately saline to a depth of 6 inches, and the lower part is moderately alkaline and strongly saline. The upper part of the subsoil, to a depth of 38 inches, is dark gray clay. The lower part to a depth of 60 inches is gray clay. This soil is strongly saline and moderately alkaline throughout the subsoil.

Included with this soil in mapping are small areas of Follet, Francitas, Placedo, Tatlum, Tracosa, and Veston soils. Follet, Francitas, Tatlum, Tracosa, and Veston soils are in slightly higher positions on the landscape than Harris soil, Tracosa soils are in slightly lower positions, and Placedo soils are in similar positions. The included soils make up less than 10 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is occasionally flooded by runoff from the uplands, unusually high spring tides, and storm tides. The high water table is at or near the surface during most of the winter.

This Harris soil is mainly used as rangeland and as habitat for wildlife. It is not suited to crop production or pastureland because of salinity and wetness. Flooding also is a hazard. This area of Harris soil is used extensively by many wetland wildlife game species.

This soil is capable of producing high yields of marsh range grasses when properly managed. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be effectively used to help maintain plant vigor. Proper location of freshwater facilities and bedding areas for cattle also helps achieve proper grazing.

For most urban uses, the main limitations are wetness, salinity, clayey texture, and low strength. Flooding is a hazard.

This Harris soil is in capability subclass VIIw. It is in the Salt Marsh range site.

ImA—Ijam clay, 0 to 2 percent slopes. This is a nearly level to gently sloping, poorly drained, saline, clayey soil that has a clayey subsoil. It is in the coastal marshes. This soil formed in materials dredged from bays and canals. The slopes average about 1 percent. The mapped areas are mostly long and narrow and range from 10 acres to several hundred acres.

Typically, this soil has a surface layer that is calcareous, moderately alkaline, dark grayish brown clay about 10 inches thick. The upper part of the underlying material, to a depth of 35 inches, is calcareous, moderately alkaline, dark gray clay. The middle part, to a depth of 56 inches, is moderately alkaline, gray clay that has a few strata of sand. The lower part to a depth of 61 inches is neutral, bluish gray sand that has a few strata of sandy clay loam. This soil is moderately saline throughout.

Included with this soil in mapping are Sievers soils. Also included are small oyster shell beds and small areas that are similar to Ijam soil. These included soils are more yellow than Ijam soil or are noncalcareous. The included soils make up less than 25 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded by storm tides. The high water table is within 1.5 feet of the surface during most of the winter. Areas where dredged material has just been added can remain boggy for several years. Although the soil is generally moderately saline, the salinity is dependent on the original salinity of the dredged material and the length of time that the dredged material has been laid down.

This Ijam soil is used mainly as habitat for wildlife and as rangeland. This soil is not suited to crop production or pasture because of salinity.

This soil will produce high yields of marsh range grasses. In areas where dredged material has just been added, the plant community may not become stable for many years. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be effectively used to maintain plant vigor. This Ijam soil is in pastures in the higher positions in the marsh. These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the main limitations are wetness, salinity, and high shrink-swell potential of the soil. Flooding is a hazard.

This Ijam soil is in capability subclass VIIw. It is in the Salty Prairie range site.

ImB—Ijam clay, 2 to 8 percent slopes. This is a gently sloping to strongly sloping, poorly drained, saline, clayey soil that has a clayey subsoil. It is in the coastal marshes. This soil formed in material dredged from the bays and canals. The slopes average about 3 percent. The mapped areas are mainly long and narrow and range from 10 acres to a few hundred acres.

Typically, this soil has a surface layer that is calcareous, dark grayish brown clay about 12 inches thick. The upper part of the underlying material, to a depth of about 45 inches, is calcareous, dark gray clay. The lower part to a depth of about 60 inches is gray clay. This soil is moderately saline, moderately alkaline throughout.

Included with this soil in mapping are the Sievers soils. Also included are small oyster shell beds and small

areas of soils that are similar to Ijam soil. These included soils are more yellow than Ijam soils or are noncalcareous. The included soils make up less than 25 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded by storm tides. The high water table is within 1.5 feet of the surface during most of the winter. Areas where dredged material has just been added can remain boggy for several years. Although the soil is generally moderately saline, the salinity is dependent on the original salinity of the dredged material and the length of time that the dredged material has been laid down.

This Ijam soil is mainly used as habitat for wildlife and as rangeland. It is not suited to crop production or pasture because of salinity.

This soil will produce high yields of marsh range grasses. In areas where dredged material has just been added, the plant community may not become stable for many years. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be effectively used to maintain plant vigor. This Ijam soil is in pastures in the higher positions in the marsh. These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the main limitations are wetness, salinity, and high shrink-swell potential of the soil. Flooding is a hazard.

This Ijam soil is in capability subclass VIIw. It is in the Salty Prairie range site.

Iu—Ijam-Urban land complex. This complex consists of a nearly level, poorly drained, moderately saline, clayey soil that has a clayey subsoil and Urban land. The slopes average about 0.5 percent. The mapped areas are irregular in shape and range from 10 acres to several hundred acres.

Ijam soil makes up 40 to 60 percent of the map unit. Urban land makes up 40 to 50 percent. Ijam soil is in the open areas. These soils are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Ijam soil has a surface layer that is calcareous, dark grayish brown clay about 12 inches thick. The upper part of the underlying material, to a depth of 40 inches, is dark gray clay. The lower part to a depth of 60 inches is a gray clay. This soil is moderately saline and moderately alkaline throughout.

Urban land consists of soils that have been altered or obscured by buildings or other structures, such as warehouses, office buildings, sidewalks, parking lots, and wharves.

Included with these soils in mapping are areas of Francitas and Sievers soils.

The soils in this complex are very slowly permeable. The surface runoff is very slow. These soils are rarely flooded by storm tides. The permanent high water table is within 18 inches of the surface during most of the winter. Although the salinity is generally moderately saline, it varies depending on the original salinity of the dredged material and the length of time since the dredged material was laid down. Because the permeability is very slow, the soils remain salty for a long period of time.

For most urban uses, the main limitations are wetness, salinity, and high shrink-swell potential of the soils. Flooding is a hazard.

The soils in this complex have not been assigned to a capability subclass or to a range site.

Ka—Karankawa mucky loam. This is a nearly level, very poorly drained, saline, loamy soil that has a loamy subsoil. It is in the tidal marshes. This map unit typically contains 5 to 20 percent barren depressions and tidal cuts. The depressions are about 0.3 of a foot deep and are up to 100 feet across. The overall slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 20 acres to several hundred acres.

Typically, this soil has a surface layer that is about 18 inches thick. It is dark gray mucky loam in the upper 10 inches and dark gray mucky fine sandy loam in the lower part. The upper part of the underlying material, to a depth of 38 inches, is light gray fine sandy loam. The lowest part to a depth of 60 inches is light gray loamy fine sand. This soil is strongly saline and moderately alkaline throughout.

Included with this soil in mapping are small areas of Follet, Mustang, and Tatlum soils. Follet and Tatlum soils are in similar positions on the landscape as Karankawa soil. Mustang soils are in higher positions. Also included are small areas of a soil that is similar to Karankawa soil, and it is also in similar positions on the landscape. This soil is sandy throughout. The included soils make up less than 20 percent of the map unit.

This soil is moderately rapidly permeable. The surface runoff is very slow. The high water table allows for very little water movement through the soil. This soil remains saturated throughout the year. It is covered daily with 2 to 12 inches of water during high tide and is frequently flooded by spring tides, storm tides, and rainstorms.

This Karankawa soil is used mainly as habitat for wildlife. It is not suited to crop production or pastureland because of wetness, flooding, and salinity. This area of Karankawa soil is used extensively by nongame wetland wildlife and is an important part of the marine estuarine system.

The potential range forage yields of this soil are medium. Although this soil produces adequate yields of

marsh range grasses, the overall production is lowered because of the barren depressional areas. This soil is seldom used as rangeland because it is boggy, does not have available freshwater and bedding areas, and is inundated by the tides. Management of these areas is difficult.

For most urban uses, the main limitations are wetness, low soil strength, and salinity. Flooding is a hazard.

This Karankawa soil is in capability subclass VIIw. It is in the Tidal Flat range site.

KeA—Kemah silt loam, 0 to 1 percent slopes. This is a nearly level, somewhat poorly drained, nonsaline, loamy soil that has a clayey subsoil. It is on the uplands. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 5 acres to 200 acres.

Typically, this soil has a surface layer that is medium acid, dark grayish brown silt loam about 10 inches thick. The subsurface layer, to a depth of 15 inches, is strongly acid, grayish brown loam that has dark red mottles. The upper part of the subsoil, to a depth of 24 inches, is medium acid, mottled dark gray and grayish brown clay. The middle part, to a depth of 38 inches, is medium acid, grayish brown clay. The lower part to a depth of 60 inches is neutral, grayish brown sandy clay loam.

Included with this soil in mapping are small areas of Aris, Bernard, Edna, Leton, and Verland soils. Aris soils are in similar positions on the landscape as Kemah soil. Bernard, Edna, and Verland soils are in lower positions. Leton soils are in depressional areas. Also included are soils that are similar to Kemah soil that are red in the upper part of the subsoil. The included soils make up less than 10 percent of the map unit.

This soil is very slowly permeable. The surface runoff is slow. This soil is rarely flooded. The high water table is within 1.5 feet of the surface during most of the winter.

This Kemah soil is mainly used as pastureland. Some acreage is used as cropland. The main crops are rice and soybeans.

This soil is moderately suited to crops. It is well suited to rice production because the soil is very slowly permeable and is easy to level. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. This soil tends to be droughty during the prolonged dry periods in the summer. It also becomes hard during dry periods. If dryland crops are grown, plowing, planting, and cultivating should be done in a timely manner when soil is moist and friable. Incorporating soil residue in the surface layer helps maintain good tilth. In areas where land leveling is needed, the soil should be checked before leveling to ensure that it does not have a highly calcareous subsoil that will be near the surface after leveling. Plants and fertilizers respond differently in these calcareous areas than they do in surrounding areas. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed. This soil tends to become droughty during prolonged dry periods in the summer.

For most urban uses, the main limitations are wetness and high shrink-swell potential of the soil.

This Kemah soil is in capability subclass IIIw. It is in the Loamy Prairie range site.

KeB—Kemah silt loam, 1 to 3 percent slopes. This is a gently sloping, somewhat poorly drained, nonsaline, loamy soil that has a clayey subsoil. It is on the uplands. The slopes average about 2 percent. The mapped areas are generally elongated and parallel the distributary channels and drainageways. They range from about 5 acres to 50 acres.

Typically, this soil has a surface layer that is strongly acid, dark grayish brown silt loam about 11 inches thick. The subsurface layer, to a depth of about 17 inches, is strongly acid, grayish brown silt loam. The upper part of the subsoil, to a depth of 35 inches, is medium acid, gray clay. The lower part, to a depth of 60 inches, is neutral, grayish brown clay. The substratum to a depth of about 70 inches is moderately alkaline, light brownish gray clay.

Included with this soil in mapping are small areas of Aris, Bernard, Edna, Lake Charles, and Verland soils. These soils are in similar positions on the landscape as Kemah soil. The included soils make up less than 35 percent of the map unit.

This soil is very slowly permeable. The surface runoff is moderate. This soil is rarely flooded. The high water table is within 1.5 feet of the surface during most of the winter.

This Kemah soil is mainly used as pastureland.

This soil is suited to crops. It is not suited to rice production because of the slope. Although the soil is capable of producing high yields, the areas are too long and narrow to economically manage and control erosion. Contour farming and terraces help to control erosion. This soil tends to be droughty during prolonged dry periods in the summer. It also becomes hard during dry periods. If dryland crops are grown, plowing, planting, and cultivating should be done in a timely manner when the soil is moist and friable. Incorporating crop residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed. The soil tends to become droughty during prolonged dry periods in the summer.

For most urban uses, the main limitations are wetness and high shrink-swell potential of the soil.

This Kemah soil is in capability subclass IIIe. It is in the Loamy Prairie range site.

Ku—Kemah-Urban land complex. This complex consists of a nearly level, somewhat poorly drained, nonsaline, loamy soil that has a clayey subsoil and Urban land. The soils in this complex are on the uplands. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 5 acres to several hundred acres.

Kemah soil makes up 30 to 60 percent of this complex. Urban land makes up 30 to 50 percent. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Kemah soil has a surface layer that is medium acid, dark grayish brown silt loam about 10 inches thick. The subsurface layer, to a depth of about 15 inches, is strongly acid, grayish brown loam that has dark red mottles. The upper part of the subsoil, to a depth of 24 inches, is medium acid, mottled dark gray and grayish brown clay. The middle part, to a depth of 38 inches, is medium acid, grayish brown clay that has yellowish brown mottles. The lower part to a depth of 60 inches is neutral, grayish brown sandy clay loam.

Urban land consists of areas that have been altered or obscured by buildings or other urban structures making classification of the soils impractical. Typically, these structures are single and multiple unit dwellings, garages, sidewalks, driveways, streets, schools, churches, shopping centers, office buildings, and parking lots. Areas of Kemah soil and of other soils that have been altered by cutting, grading, and filling make up some Urban land. In some places, the soil has not been altered but has been covered by up to 24 inches of fill material.

Included in mapping are areas of Aris, Bernard, Edna, and Lake Charles soils.

The soils in this complex are very slowly permeable. The surface runoff is slow. These soils are rarely flooded. A high water table is within 1.5 feet of the surface during most of the winter.

For most urban uses, the main limitations are wetness and high shrink-swell potential of the soils.

The soils in this complex have not been assigned to a capability subclass or to a range site.

LaA—Lake Charles clay, 0 to 1 percent slopes. This is a nearly level, somewhat poorly drained, nonsaline, clayey soil that has a clayey subsoil. It is on broad uplands. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 5 acres to about 3,000 acres.

Typically, this soil has a surface layer that is very dark gray clay about 24 inches thick. The upper part of the subsoil, to a depth of about 51 inches, is dark gray clay. The lower part to a depth of 62 inches is gray clay. This soil is medium acid in the upper part and grades to moderately alkaline in the lower part.

Included with this soil in mapping are small areas of Bacliff, Bernard, Edna, Vamont, and Verland soils. Bacliff soils are in slightly lower positions on the landscape than Lake Charles soil; Bernard, Edna, and Verland soils are in slightly higher positions; and Vamont soils are in similar positions. Also included is a soil that is similar to Lake Charles soil but has a subsoil that is more brown. The included soils make up less than 5 percent of the map unit except in some areas the browner soil that is similar to Lake Charles soil makes up about 60 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded. During most of the winter, a high water table is within a depth of 1.5 feet.

This Lake Charles soil is used as cropland, pastureland, or rangeland. The main crops include rice and soybeans (fig.2). Some grain sorghum also is grown.

This soil is well suited to crops. It is also well suited to rice production because it is very slowly permeable, level, and requires little leveling to flood it evenly. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. Because the soil has a clayey surface layer, it is difficult to till when dry; and when dry, it develops large cracks. In this condition, water readily enters the soil; and as the soil becomes moist, the cracks seal and water movement through the soil is very slow. Incorporating crop residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses (fig. 3). A system of field drains that have adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness, clayey texture, and high shrink-swell potential of the soil.

This Lake Charles soil is in capability subclass IIw. It is in the Blackland range site.

Figure 2.—This rice crop is growing on Lake Charles clay, 0 to 1 percent slopes.

LaB—Lake Charles clay, 1 to 5 percent slopes. This is a gently sloping somewhat poorly drained, clayey soil that has a clayey subsoil. It is on the uplands and is generally adjacent to creeks and bayous. The slopes average about 3 percent. The mapped areas are generally long and narrow and range from 5 acres to several hundred acres.

Typically, this soil has a surface layer that is very dark gray clay loam about 38 inches thick. Reaction is medium acid in the upper part of the surface layer and neutral in the lower part. The upper part of the subsoil, to a depth of 55 inches, is mildly alkaline, dark gray clay. The lower part to a depth of 60 inches is moderately alkaline, gray clay.

Included with this soil in mapping are small areas of Aris, Bernard, Edna, Kemah, and Verland soils and also some areas of the nearly level Lake Charles soils. These soils are in similar positions on the landscape as Lake Charles soils. The included soils make up less than 15 percent of the map unit.

This soil is very slowly permeable. The surface runoff is slow. This soil is occasionally flooded. The high water table is within 2 feet of the surface during most of the winter.

This Lake Charles soil is mainly used as pastureland and habitat for wildlife.

This soil is suited to crops. It is not suited to rice production because of slope. Although the soil will produce high yields of many crops, only a few areas are used as cropland because of the extra effort that is required to control erosion and maintain high yields. Many places need terraces, grassed waterways, or diversions to control erosion. Also, most areas of this soil occur as narrow strips and bands along drainageways; therefore, it is not economically feasible to till these areas.

Figure 3.—A rice-pasture rotation system is used in this area of Lake Charles clay, 0 to 1 percent slopes. The pasture is volunteer vegetation.

This soil is well suited to pasture plants. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness, clayey texture, and high shrink-swell potential of the soil.

This Lake Charles soil is in capability subclass IIIe. It is in the Blackland range site.

Lb—Lake Charles-Urban land complex. This complex consists of a nearly level, somewhat poorly drained, nonsaline, clayey soil that has a clayey subsoil and Urban land. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 5 acres to several hundred acres.

Lake Charles soil makes up 35 to 75 percent of the map unit and Urban land makes up 25 to 60 percent. Lake Charles soil is in open lots, yards, and other open areas. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Lake Charles soil has a surface layer that is very dark gray clay about 38 inches thick. Reaction in the upper part of the surface layer is medium acid, and is neutral in the lower part. The subsoil extends to a depth of 60 inches. The upper part of the subsoil is mildly alkaline, dark gray clay. The lower part is moderately alkaline, gray clay.

Urban land consists of soils that have been altered or obscured by buildings or other structures making classification of the soils impractical. Typical structures are single and multiple unit dwellings, garages, sidewalks, driveways, streets, schools, churches, shopping centers, office buildings, parking lots, and industrial sites. Areas of the Lake Charles soil and of other soils that have been altered by cutting, grading, and filling make up some Urban land. In some places, the soil has not been altered but is covered by 6 to 24 inches of fill material.

Included in mapping are areas of Bacliff, Bernard, and Verland soils.

The soils in this complex are very slowly permeable. The surface runoff is very slow. These soils are rarely flooded. The high water table is within 1.5 feet of the surface during most of the winter.

For most urban uses, the main limitations are wetness, clayey texture, and high shrink-swell potential of the soils.

The soils in this complex have not been assigned to a capability subclass or to a range site.

Le—Leton loam. This is a nearly level, poorly drained, nonsaline, loamy soil that has a loamy subsoil. It is in old stream meanders and depressional areas on the uplands. The slopes average about 0.3 percent. The mapped areas range from oblong to long and narrow in old stream meanders and are generally circular in the depressional areas that are not associated with stream meanders. These areas range from 5 acres to about 200 acres.

Typically, this soil has a surface layer that is neutral, dark gray loam about 5 inches thick. The subsurface layer, to a depth of 12 inches, is neutral, gray loam. The upper part of the subsoil, to a depth of 26 inches, is neutral, gray clay loam mixed with some gray loam. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light gray clay loam.

Included with this soil in mapping are small areas of Aris, Edna, Lake Charles, and Verland soils. These soils are in higher positions on the landscape than Leton soils. Also included is a soil that is similar to Leton soil that has a clayey subsoil. This soil is in higher positions on the landscape than Leton soil. The included soils make up less than 15 percent of the map unit.

This soil is slowly permeable above the high water table. The surface runoff is very slow, or the soil is ponded. This soil is occasionally flooded. In areas that have not been drained or leveled, up to 1.5 feet of water stands on the surface during the winter, especially in the depressional areas. In leveled or drained areas, the water table is within 1 foot of the surface during most of the winter.

This Leton soil is used as pastureland, cropland, or rangeland. The main crops are rice and soybeans. Some grain sorghum is also grown.

This soil is moderately suited to crops. It is also moderately suited to rice production because it is slowly permeable. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. This soil is in the lowest part of the landscape and receives additional runoff from the surrounding areas. A system of field drains that have adequate outlets is needed to remove excess surface water and maintain consistent crop yields. Leveling is more difficult in the enclosed depressional areas because large amounts of fill material from the surrounding areas are needed to fill these depressions. This soil tends to remain wet for longer periods than soils in the surrounding areas. A well planned fertilizer program is essential to obtain high yields.

This soil is moderately suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water and to increase production of pasture grasses. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing moderate yields of native range forage when properly managed. The native plant community consists of water-tolerant grasses, sedges, and rushes that are less productive and palatable than other grasses.

For most urban uses, the main limitation is wetness. Flooding is a hazard.

This Leton soil is in capability subclass IVw. It is in the Lowland range site.

Ls—Leton-Aris complex. This complex consists of nearly level, poorly drained and somewhat poorly drained, nonsaline, loamy soils that have a loamy and clayey subsoil. These soils are on the uplands. This map unit is associated with old stream meander systems. This complex consists of circular to oblong depressional areas and of circular mounds or knolls. The mounds are about 2 feet higher than the surrounding intermound areas and are 15 to 40 feet across. The overall slopes average about 0.3 percent. The mapped areas are generally oblong and range from 10 acres to several hundred acres.

Leton soil makes up 30 to 50 percent of the map unit. Aris soil makes up 30 to 40 percent. Edna soil, which was included with Leton and Aris soils in mapping, makes up 10 to 25 percent. Leton soil is in the circular to oblong depressional areas. This soil is poorly drained. Aris soil is on the circular mounds or knolls and also is in some of the intermound areas. This soil is somewhat poorly drained. In areas that have been leveled, much of the surface layer of Aris soil has been removed and added to the surface of Leton soil. The soils in this map unit are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, in unleveled areas, Leton soil has a surface layer that is neutral dark gray loam about 5 inches thick. The subsurface layer, to a depth of 21 inches, is neutral gray loam. The upper part of the subsoil, to a depth of 28 inches, is gray clay loam that is about 25 percent tongues and streaks of loam. The lower part to a depth of 60 inches is gray clay loam. The subsoil is moderately alkaline throughout.

Typically, in unleveled areas, Aris soil has a surface layer of medium acid, dark grayish brown fine sandy loam about 10 inches thick. The subsurface layer, to a

depth of 19 inches, is medium acid, grayish brown fine sandy loam. The upper part of the subsoil, to a depth of 45 inches, is moderately alkaline, gray clay loam that is mixed with about 20 percent grayish brown fine sandy loam in the upper 12 inches. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, gray clay.

Included with these soils in mapping are areas of Edna, Bernard, Cieno, Kemah, and Verland soils.

Leton soil is slowly permeable above the high water table. The surface runoff is very slow to ponded. Aris soil is very slowly permeable. The surface runoff is very slow. These soils are rarely flooded. In unleveled areas, a perched water table is within 1.5 feet of the surface during most of the winter in the intermound areas, at a depth of 3 feet in the mound areas, and is 6 inches below the surface to 6 inches above the surface in depressional areas. In leveled areas, a perched water table is within 1.5 feet of the surface during most of the winter.

The soils in this complex are mainly used as rangeland or pastureland. Some areas of these soils are used as cropland. The main crops are rice and soybeans. Some grain sorghum also is grown.

These soils are suited to crops. They are poorly suited to rice production because they are difficult to level. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor for crop production. Leveling also makes farming operations easier. Before leveling an area, two factors should be considered. First, the subsoil in the mound areas can be so near the surface after leveling that most of the plant root zone is moderately alkaline. This causes plants and fertilizer to respond differently than in surrounding areas, especially on soils used for rice production. Second, in the areas where the mounds are located, the soil can become salty after leveling and crop yields will be reduced. These soils tend to be droughty during prolonged dry periods in the summers in the mounds and intermound areas. The depressional areas remain wet for extended periods. These soils also become hard during these dry periods. If dryland crops are grown, plowing, planting, and cultivating should be done in a timely manner when the soil is friable and moist. Incorporating soil residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

These soils are moderately suited to pasture grasses. In unleveled areas, the uneven topography allows the surface of the mounds and intermounds to dry faster than it does in the depressional areas. These depressional areas remain wet for long periods. Forage production and quality are low in depressional areas. A system of field drains that has adequate outlets is needed to remove excess surface water from the depressions. A grazing management program that includes fertilization increases forage production and improves quality.

The soils in this map unit are capable of producing high yields of native range grasses when properly managed. Forage production and forage quality in the depressional areas will be low.

For most urban uses, the main limitations are wetness, shrink-swell potential, and the uneven topography of the soils.

The soils in this complex are in capability subclass IVw. Leton soil is in the Lowland range site. Aris soil is in the Loamy Prairie range site.

Lx—Leton-Lake Charles complex. This complex consists of nearly level, poorly drained and somewhat poorly drained, nonsaline, loamy and clayey soils that have a loamy and clayey subsoil. These soils are on the uplands. The overall surface is plane, but it is a series of numerous small, oblong to elongated ridges about 0.2 of a foot high with small, oblong to elongated, plane to slightly concave flats. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 5 acres to more than 100 acres.

Leton soil makes up 40 to 50 percent of the map unit. Lake Charles soil makes up 30 to 40 percent. Leton soil is generally on the small ridges. It is poorly drained. Lake Charles soil is on the lower flats. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Leton soil has surface and subsurface layers that are medium acid loam about 20 inches thick. The surface layer is dark gray. The subsurface layer is gray. The upper part of the subsoil, to a depth of 33 inches, is neutral, gray clay loam that has tongues of loamy material. The middle part and lower part of the subsoil to a depth of 60 inches is neutral clay loam. The middle part is gray, and the lower part is light gray.

Typically, Lake Charles soil has surface layer that is very dark gray clay about 50 inches thick. Reaction in the upper part of the surface layer is medium acid and neutral in the lower part. The upper part of the subsoil, to a depth of 55 inches, is neutral, dark gray clay. The lower part to a depth of 62 inches is moderately alkaline, gray clay.

Included with these soils in mapping are areas of Bacliff, Bernard, and Verland soils.

Leton soil is slowly permeable. The surface runoff is very slow. Lake Charles soil is very slowly permeable. The surface runoff is very slow. The soils in this map unit are rarely flooded. A perched water table is within 1.5 feet of the surface during most of the winter.

The soils in this complex are mainly used as pastureland or cropland. The main crops are rice and soybeans. Some grain sorghum is also grown.

These soils are moderately suited to crops. They are also moderately suited to rice production because they

are slowly or very slowly permeable and are easy to level. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor for crop production. A well planned fertilizer program is essential to obtain high yields.

These soils are well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management program that includes fertilization increases forage production and improves quality.

These soils are capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness and shrink-swell potential of the soils.

The soils in this complex are in capability subclass IVw. Leton soil is in the Lowland range site, and Lake Charles soil is in the Blackland range site.

Ma—Mocarey loam. This is a nearly level, somewhat poorly drained, nonsaline, loamy soil that has a loamy subsoil. It is on the uplands. This map unit typically has a few circular pimple mounds. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 5 acres to about 400 acres.

Typically, this soil has a surface layer that is mildly alkaline very dark gray loam about 12 inches thick. The upper part of the subsoil, to a depth of 22 inches, is dark gray clay loam. The middle part, to a depth of 38 inches, is calcareous, light gray loam that has many masses of calcium carbonate. The lower part of the subsoil, to a depth of 52 inches, is calcareous, light gray loam. The substratum to a depth of 60 inches is light gray clay loam. Reaction is moderately alkaline throughout the subsoil.

Included with this soil in mapping are small areas of Algoa, Bernard, Cieno, Edna, Leton, Morey, and Verland soils. Algoa soils are generally in slightly higher positions on the landscape than Mocarey soil; Bernard, Cieno, Edna, Leton, and Verland soils are in slightly lower positions; and Morey soils are in similar positions. The included soils make up less than 20 percent of the map unit.

This soil is slowly permeable above the high water table. The surface runoff is very slow. This soil is rarely flooded. The high water table is within 2 feet of the surface during most of the winter.

This Mocarey soil is mainly used as pastureland or cropland. The main crops are soybeans and some grain sorghum. Some specialty crops, such as onions and collard greens (fig. 4), are also grown.

This soil is well suited to crops. It is moderately suited to rice production because some leveling is required to flood it evenly. This soil commonly has a zinc deficiency when it is flooded for rice production. If this deficiency is not corrected, yields are reduced. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality. This soil is also used for native hay meadows.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitation is wetness.

This Mocarey soil is in capability subclass IIIw. It is in the Loamy Prairie range site.

Mb—Mocarey-Algoa complex. This complex consists of gently undulating, somewhat poorly drained, nonsaline, loamy soils that have a loamy subsoil. These soils are on the uplands. This map unit is generally associated with old stream meander systems. Although the overall surface is plane, it has 20 to 40 percent pimple mounds. In unleveled areas, the mounds are about 1.5 feet high and are 15 to 40 feet across. The slopes average about 0.3 percent. The mapped areas are generally oblong and range from 10 acres to hundreds of acres.

Mocarey soil makes up 30 to 50 percent of the map unit, and Algoa soil makes up 15 to 30 percent. Mocarey soil is typically in the intermound areas, but it also occurs on the mounds. Algoa soil is typically on the small pimple mounds or knolls, but it also occurs in the intermound areas (fig. 5). The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, in unleveled areas, the surface layer of Mocarey soil is moderately alkaline, very dark gray silty clay loam about 11 inches thick. The subsoil to a depth of 60 inches is moderately alkaline, dark gray clay loam in the upper part and gray clay loam in the lower part. It contains brownish mottles, pitted concretions of calcium carbonate, and black concretions. Reaction is moderately alkaline throughout.

Typically, in unleveled areas, the surface layer of Algoa soil is very dark gray silt loam about 12 inches thick. The upper part of the subsoil, to a depth of about 18 inches, is calcareous, grayish brown loam. The middle part, to a depth of 43 inches, is calcareous, light brownish gray loam. The lower part to a depth of about 58 inches, is light gray loam. The substratum to a depth of 65 inches is light gray clay loam. Reaction is mildly alkaline in the surface layer and is moderately alkaline in the subsoil and substratum.

Included with these soils in mapping are areas of Bernard, Cieno, Leton, and Morey soils. Also included is a soil that is similar to Mocarey soil but has a surface

Figure 4.—Onions and collard greens are two specialty crops that can be grown on soils such as Mocarey loam.

layer that is lighter in color. In many areas, the dark surface layer of the mounds is partly or totally removed. This layer was often used as a source of topsoil, and it is still occasionally used. In areas that have been leveled, the dark surface layer of the mounds was spread throughout the intermound areas.

The permeability is slow in Mocarey soil and moderately slow in Algoa soil. The surface runoff is slow to medium. These soils are rarely flooded. During most of the winter, a perched water table is within 2 feet of the surface in the intermound areas and is within 3 feet of soil surface in the mound areas, if they are present.

The soils in this complex are mainly used as pastureland or cropland. Some areas are used as rangeland. The main crop is soybeans. Some grain sorghum also is grown.

These soils are moderately suited to crops. They are also moderately suited to rice production because leveling is difficult and water loss in these soils is more than in other rice-growing soils. These soils also commonly have a zinc deficiency when they are flooded for rice production. If this deficiency is not properly treated, yields are reduced. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor in managing water for crop production. Leveling also makes farming operations easier. Before leveling an area, two factors should be considered. First, the highly calcareous subsoil can be so near the surface after leveling that most of the plant root zone is calcareous. This causes plants and fertilizer to respond differently than in surrounding areas, especially on soils used for rice production. Second, in the areas where the mounds are located, the soils can become salty after leveling and crop yields will be reduced (fig. 6). A well planned fertilizer program is essential to obtain high yields.

These soils are well suited to pasture grasses. In unleveled areas, the uneven topography allows the surface of the mounds to dry faster than it does in the

intermound areas. A system of field drains that has adequate outlets is needed to remove excess surface water from the intermounds and allows more even grazing. A grazing management program that includes fertilization increases forage production and improves quality.

The soils in this map unit are capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness and the uneven topography of the soils.

The soils in this complex are in capability subclass IIIw. These soils are in the Loamy Prairie range site.

Mc—Mocarey-Cieno complex. This complex consists of gently undulating, somewhat poorly drained and poorly drained, nonsaline, loamy soils that have a loamy subsoil. These soils are on the uplands. This map unit is generally associated with old stream meander systems. Although the overall surface is plane, it has 15 to 45 percent pimple mounds or long ridges and 15 to 30 percent shallow depressions. In unleveled areas, the mounds and ridges are about 1 foot high. The mounds are 15 to 40 feet across. The ridges are mostly about 70 feet wide and several hundred feet long. The depressions are about 0.5 of a foot lower than the intermounds and are 20 to 100 feet across. The overall slopes average about 0.5 percent. The mapped areas are generally oblong and range from 10 acres to several hundred acres.

Mocarey soil makes up 20 to 50 percent of the map unit. Cieno soil makes up 15 to 30 percent. Algoa soil, an included soil in mapping, makes up 10 to 20 percent. Mocarey soil is typically in the intermound area but also is on the mounds and ridges. This soil is somewhat poorly drained. Cieno soil is in the shallow depressional areas. It is poorly drained. Algoa soil typically is on the circular mounds or ridges but also is in the intermound areas. In many of the mound areas, the dark surface layer has been partly or totally removed for topsoil. The soils from the mounds are still used occasionally as a source of topsoil. In land leveling operations, this material is also spread to fill the depressions. This results in a spotted, light and dark landscape. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, in unleveled areas, Mocarey soil has a surface layer that is neutral, very dark grayish brown loam about 8 inches thick. The upper part of the subsoil, to a depth of 12 inches, is mildly alkaline, very dark grayish brown loam. The lower part, to a depth of 52 inches, is moderately alkaline, dark gray clay loam. The substratum to a depth of 60 inches is moderately alkaline, gray clay.

Figure 5.—Mounds are a part of the surface relief in areas of Mocarey-Algoa complex. The light, circular mounds are Algoa soil, and the dark areas are Mocarey soil.

Figure 6.—The soils in this area of Mocarey-Algoa complex have been leveled. Mocarey soil is in the dark areas, and Algoa soil is in the light areas. Salt has crusted the surface of the Algoa soil.

Typically, in unleveled areas, Cieno soil has a surface layer that is 11 inches thick. It is neutral, dark gray silt loam in the upper 7 inches. The lower part is neutral, grayish brown silt loam. The upper part of the subsoil, to a depth of 32 inches, is gray clay loam. The middle part, to a depth of 43 inches, is light gray clay loam. The lower part to a depth of 60 inches is light brownish gray clay loam. The subsoil is moderately alkaline throughout.

Included with these soils in mapping are areas of Algoa, Bernard, and Leton soils. Also included is a soil that is similar to Mocarey soil but its surface layer is a lighter color.

Mocarey soil is slowly permeable above the water table. The surface runoff is slow to very slow. Cieno soil is very slowly permeable above the water table. The surface runoff is very slow. These soils are rarely flooded. In unleveled areas, a perched water table is within 2 feet of the surface during most of the winter in the intermound areas and on the ridges, is at a depth of 2.5 feet on the mounds, and is 12 inches below the surface to 2 inches above the surface in depressional areas. In leveled areas, a perched water table is within 2 feet of the surface during most of the winter.

The soils in this complex are mainly used as cropland or pastureland. Some areas are used as rangeland. The main crop is soybeans. Some grain sorghum (fig. 7) is also grown.

These soils are moderately suited to crops. They are moderately suited to rice production because levelling is difficult and water loss in these soils is more than in other rice-growing soils. These soils also have a zinc deficiency in the moderately alkaline areas when they are flooded for rice production. If this deficiency is not properly treated, yields are reduced. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor for crop production. Leveling also makes farming operations

Figure 7.—Soybeans is the main crop grown on Mocarey-Cieno complex.

easier. Before leveling an area, two factors should be considered. First, the highly calcareous subsoil on the ridges, mounds, and intermounds can be so near to the surface after leveling that most of the plant root zone is calcareous. This causes plants and fertilizer to respond differently than in surrounding areas, especially on soils used for rice production. Second, in the areas where the mounds are located, the soils can become salty after leveling and crop yields will be reduced. A well planned fertilizer program is essential to obtain high yields.

These soils are well suited to pasture grasses. The depressions remain wet for significant periods in unleveled areas; therefore, overall production is somewhat reduced. A system of field drains that has adequate outlets is needed to remove excess surface water from the depressions. A grazing management program that includes fertilization increases forage production and improves quality.

The soils in this map unit are capable of producing high yields of native range grasses when properly managed. The forage production and forage quality in the depressional areas are somewhat low.

For most urban uses, the main limitations are wetness and the uneven topography of the soils.

The soils in this complex are in capability subclass IVw. Mocarey soil is in the Loamy Prairie range site. Cieno soil is in the Lowland range site.

Md—Mocarey-Leton complex. This complex consists of gently undulating, somewhat poorly drained and poorly drained, nonsaline, loamy soils that have a loamy subsoil. These soils are on the uplands. This map unit is generally associated with old stream meander systems. Although the overall surface is plane, it has 15 to 35 percent pimple mounds and 20 to 40 percent depressions. In unleveled areas, the mounds are about 2 feet high and 15 to 40 feet across. The depressions are about 1 foot lower than the intermounds and are 40 to 300 feet across. In leveled areas, the depressions are only slightly low areas. The overall slopes average about

0.3 percent. The mapped areas are generally oblong and range from 10 acres to several thousand acres.

Mocarey soil makes up 20 to 50 percent of the map unit. Leton soil makes up 20 to 40 percent. Algoa soil, an included soil in mapping, makes up 10 to 20 percent. Mocarey soil typically is in the intermound areas but also is on the mounds. This soil is somewhat poorly drained. Leton soil is in the depressional areas. It is poorly drained. Algoa soil typically is in the intermound areas but also is on the mounds. In many of the mound areas, the dark surface layer has been partly or totally removed for topsoil. The soils from the mounds are still used occasionally as a source of topsoil. This material is also spread to fill in depressions during land leveling operations. This results in a spotted, light and dark landscape. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, in unleveled areas, Mocarey soil has a surface layer that is slightly acid, very dark gray loam about 12 inches thick. The upper part of the subsoil, to a depth of 24 inches, is mildly alkaline, dark gray clay loam. The lower part to a depth of 60 inches is moderately alkaline, gray clay loam that has concretions of calcium carbonate.

Typically, in unleveled areas, Leton soil has a surface layer that is medium acid, dark gray loam about 6 inches thick. The subsurface layer, to a depth of 20 inches, is strongly acid, gray loam. The upper part of the subsoil, to a depth of 31 inches, is neutral, gray clay loam mixed with 20 percent loam. The middle part, to a depth of 55 inches, is moderately alkaline, gray clay loam. The lower part to a depth of 60 inches is moderately alkaline, light brownish gray clay loam.

Included with these soils in mapping are areas of Algoa, Bernard, Cieno, Morey, and Verland soils. Also included is a soil that is similar to Mocarey soil, but it has a surface layer that is a lighter color.

Mocarey soil is slowly permeable. The surface runoff is slow to very slow. Leton soil is slowly permeable above the high water table. The surface runoff is very slow to ponded. These soils are rarely flooded. In unleveled areas, a perched water table is within 2 feet of the surface during most of the winter in the intermounds, is within 3 feet of the surface on the mounds, and is above the surface in the depressions. In some depressions, water is up to a foot deep for long periods. In leveled areas, a perched water table is within 2 feet of the surface during most of the winter.

The soils in this complex are mainly used as cropland or pastureland. Some areas are used as rangeland. The main crop is soybeans. Some grain sorghum is also grown.

These soils are moderately suited to crops. They are poorly suited to rice production because of the complex topography of the soils, which makes leveling difficult, and water loss in these soils is more than in other rice-growing soils. These soils also have a zinc deficiency in the moderately alkaline areas when they are flooded for rice production. If this deficiency is not properly treated, yields are reduced. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor for crop production. Leveling also makes farming operations easier. Before leveling an area two factors are to be considered. First, the highly calcareous subsoil in the mound and intermound areas can be so near to the surface after leveling that most of the plant root zone is calcareous. This causes plants and fertilizer to respond differently than in surrounding areas, especially on soils used for rice production. Second, in the areas where the mounds are located, the soils can become salty after leveling and crop yields will be reduced. A well planned fertilizer program is essential to obtain high yields.

These soils are well suited to pasture grasses. In unleveled areas, the uneven topography allows the soils on the surface of the mounds and intermounds to dry faster than the soils in the depressions. The depressions remain wet for long periods. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management program that includes fertilization increases forage production and improves quality.

The soils in this map unit are capable of producing high yields of native range grasses when properly managed. The forage production and forage quality in the depressional areas are somewhat low.

For most urban uses, the main limitations are wetness and the uneven topography of the soils.

The soils in this complex are in capability subclass IVw. Mocarey soil is in the Loamy Prairie range site. Leton soil is in the Lowland range site.

Me—Morey silt loam. This is a nearly level, poorly drained, nonsaline, loamy soil that has a loamy subsoil. It is on the uplands. This map unit typically contains a few circular pimple mounds. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 5 acres to about 400 acres.

Typically, this soil has a surface layer that is medium acid, very dark gray silt loam about 9 inches thick. The upper part of the subsoil, to a depth of 11 inches, is medium acid, very dark gray silt loam. The next layer, to a depth of 28 inches, is neutral, dark gray clay loam. The next layer, to a depth of 43 inches, is neutral, gray clay loam. The lower part of the subsoil to a depth of 60 inches is mildly alkaline, light gray clay loam.

Included with this soil in mapping are small areas of Bernard, Edna, Leton, Mocarey, and Verland soils. Bernard, Edna, and Verland soils are in slightly lower positions on the landscape than Morey soil; Leton soils are in depressional areas; and Mocarey soils are in

similar positions. The included soils make up less than 20 percent of the map unit.

This soil is slowly permeable above the high water table. The surface runoff is very slow. This soil is rarely flooded. The high water table is within 2 feet of the surface during most of the winter.

This Morey soil is mainly used as pastureland or cropland. The main crop is soybeans. Some rice and grain sorghum are also grown.

This soil is well suited to crops. It is moderately suited to rice production because some leveling is required to flood it evenly. It requires removing the mounds that are generally present in an unleveled area. This can generally be done with farm leveling equipment. A well designed surface water management system that includes proper direction, drainage, leveling, and irrigation water management is an important factor for crop production. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality. This soil is also used for native hay meadows.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness and clayey texture of the soil.

This Morey soil is in capability subclass IIIw. It is in the Loamy Prairie range site.

Mf—Morey-Leton complex. This complex consists of gently undulating, poorly drained, nonsaline, loamy soils that have a loamy subsoil. These soils are on the uplands. This complex is generally associated with old stream meander systems. Although the overall surface is plane, it has 30 to 60 percent intermounds, 20 to 45 percent pimple mounds, and 10 to 30 percent depressions. In unleveled areas, the mounds are about 1.5 feet higher than the intermound areas and are 15 to 40 feet across. In leveled areas, the depressions are only slightly lower areas. The overall slopes average about 0.3 percent. The mapped areas are generally oblong and range from 10 acres to several hundred acres.

Morey soil makes up 30 to 60 percent of the map unit. Leton soil makes up 20 to 40 percent, and a soil that is included with Morey and Leton soils in mapping but is similar to Mocarey soils, makes up 10 to 20 percent. Morey soil typically is in the intermound areas but also is on the mounds. Leton soil is in the depressional areas. The soil that is included with these soils in mapping are similar to Mocarey soils but does not have accumulations of calcium carbonate. This soil typically is on the pimple mounds. In many areas, the dark surface layer on the mounds has been partly or totally removed for topsoil. The soils from the leveled areas are still used occasionally as a source of topsoil. This material is also spread to fill in depressions in the land leveling operations. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, in unleveled areas, Morey soil has a surface layer that is medium acid, very dark gray loam about 11 inches thick. The upper part of the subsoil, to a depth of 18 inches, is neutral, dark gray clay loam. The lower part to a depth of 60 inches is moderately alkaline, gray clay loam.

Typically, in unleveled areas, Leton soil has a surface layer that is medium acid dark gray loam about 6 inches thick. The subsurface layer, to a depth of 12 inches, is medium acid, grayish brown loam. The upper part of the subsoil, to a depth of 38 inches, is mildly alkaline, gray sandy clay loam mixed with 20 percent loamy material. The middle part, to a depth of 50 inches, is moderately alkaline, gray sandy clay loam. The lower part to a depth of 60 inches is moderately alkaline, gray clay loam.

Included with these soils in mapping are areas of Bernard, Cieno, Mocarey, and Verland soils. Also included is a soil that is similar to Morey soil, but it has a surface layer that is a lighter color. It also does not have accumulations of calcium carbonate.

The soils in this complex are slowly permeable above the water table. On Morey soil, the surface runoff is very slow. On Leton soil, the surface runoff is very slow to ponded. These soils are rarely flooded. In unleveled areas, a perched water table is within 2 feet of the surface during most of the winter in the intermounds areas, is within 3 feet of the surface on the mounds, and is above the surface in the depressions. In some depressions, water is about 1 foot deep for long periods. In leveled areas, a perched water table is within 2 feet of the surface during most of the winter.

The soils in this complex are mainly used as cropland or pastureland. Some areas are used as rangeland. The main crop is soybeans. Some grain sorghum is also grown.

These soils are moderately suited to crops. They are poorly suited to rice production because of the complex topography of the soils, which makes leveling difficult, and water loss in these soils is more than in the other rice-growing soils. These soils have a zinc deficiency when they are flooded for rice production. If this deficiency is not properly treated, yields are reduced. A well designed surface water management system that includes drainage, proper row direction, leveling, and irrigation water management is an important factor for crop production. Leveling also makes farming operations easier. Before leveling an area, two factors are to be considered. First, the calcareous subsoil that sometimes occurs in the mounds and intermound areas can be so near the surface after leveling that most of the plant root zone is calcareous. This causes plants and fertilizer to

respond differently than in surrounding areas, especially on soils used for rice production. Second, in the areas where the mounds are located, the soils can become salty after leveling and crops yields will be reduced. A well planned fertilizer program is essential to obtain high yields.

These soils are moderately suited to pasture grasses. In depressional areas, the soils remain wet for long periods. This decreases overall forage production and limits the selection of adapted grasses that can be planted in these areas. In leveled areas, the soils in the depressions do not retain much water; therefore, the selection of grasses that can be planted in these areas is not limited. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management program that includes fertilization increases forage production and improves quality.

The soils in this map unit are capable of producing high yields of native range grasses when properly managed. The forage production and forage quality in the depressional areas are somewhat low.

For most urban uses, the main limitations are wetness and the uneven topography of the soils.

The soils in this complex are in capability subclass of IVw. Morey soil is in the Loamy Prairie range site. Leton soil is in the Lowland range site.

Mn—Mustang fine sand. This is a nearly level, poorly drained, nonsaline, sandy soil. It is in the coastal areas. The surface is plane to slightly convex. The slopes range from 0.2 to 1 percent. The mapped areas are irregular in shape and range from 10 acres to several hundred acres.

Typically, this soil has a surface layer that is mildly alkaline, dark gray fine sand about 3 inches thick. The upper part of the underlying material, to a depth of 7 inches, is moderately alkaline, grayish brown fine sand. The lower part to a depth of 60 inches is moderately alkaline, gray fine sand. This soil is nonsaline throughout.

Included with this soil in mapping are small areas of Galveston; Mustang, saline; Nass; and Veston soils. Galveston soils are in slightly higher positions on the landscape than Mustang soil. Mustang, saline, soils and Nass, and Veston soils are in slightly lower positions. Also included is a soil that is similar to Mustang soil except it has a high water table within 10 inches of the surface throughout the year. The included soils make up less than 15 percent of the map unit.

This soil is rapidly permeable above the high water table. The surface runoff is very slow. The high water table is within 1 foot of the surface during most of the year. This soil is occasionally flooded by storm tides. Although the surface is generally nonsaline, it becomes slightly saline from salt spray during prolonged dry periods. However, the salt is readily leached from the soil during rainy periods. This soil is also susceptible to wind erosion if it is left unprotected after being disturbed.

This Mustang soil is mainly used as rangeland. This soil is not suited to cropland or pastureland because of plant exposure to salt spray, wetness, and sandy texture.

This soil produces high yields of native range grasses when properly managed. Plant vigor can be maintained by proper stocking and by using a rotation grazing system. Prescribed burning also can effectively be used to maintain plant vigor. This Mustang soil is in large pastures in the higher positions in the marsh (fig. 8). These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the main limitation is wetness. The susceptibility to flooding by storm tides, wind damage by hurricanes, and the susceptibility to wind erosion when the soil is left unprotected for long periods are severe hazards. Because of the proximity of the areas of this soil to the beaches of the Gulf of Mexico, these areas are often used as sites for weekend and summer cottages and for other related urban uses.

This Mustang soil is in capability subclass VIw. It is in the Low Coastal Sand range site.

Mp—Mustang fine sand, saline. This is a nearly level, poorly drained, saline, sandy soil. It is in the coastal areas. The surface is plane to slightly convex. The slopes range from 0.2 to 1 percent. The mapped areas are irregular in shape and range from 10 areas to several hundred acres.

Typically, this soil has a surface layer that is neutral, moderately saline, light gray fine sand about 13 inches thick. The next layer, to a depth of about 20 inches, is moderately alkaline, moderately saline, light brownish gray fine sand. The next layer to a depth of 60 inches is moderately alkaline, strongly saline, light gray fine sand.

Included with this soil in mapping are small areas of Karankawa, Nass, Veston, and Mustang fine sand soils. Karankawa soils are in slightly lower positions on the landscape than Mustang soil. Nass and Veston soils are in slightly higher positions. Mustang soils are not saline. The included soils make up less than 15 percent of the map unit.

This soil is rapidly permeable above the high water table. The surface runoff is very slow. The high water table is within 0.5 of a foot of the surface throughout most of the year. This soil is frequently flooded by abnormally high spring tides and storm tides. The salinity is generally moderately saline, but it becomes strongly saline for some periods during the year.

This Mustang soil is mainly used as rangeland. It is not suited to cropland or pastureland because of plant exposure to salt spray, wetness, and sandy texture.

The potential range forage yields of this soil are low. This soil produces a scattered stand of marsh grasses

Figure 8.—These cattle are resting on Mustang fine sand in the Low Coastal Sand range site. The area has been mowed to control unpalatable plants.

that is partly made up of low quality, unpalatable grasses. Plant vigor can be maintained by proper stocking and by using a rotation grazing system. Prescribed burning can be used in some cases to maintain plant vigor.

For most urban uses, the main limitation is wetness. The susceptibility to flooding by storm tides and wind damage by hurricanes are severe hazards.

This Mustang soil is in capability subclass VIw. It is in the Coastal Swale range site.

Ms—Mustang fine sand, slightly saline-strongly saline complex. This complex consists of nearly level to gently sloping, poorly drained, nonsaline and saline, sandy soils. These soils are in the coastal areas. This map unit is a complex of salinity phases. It generally parallels the area immediately above the tidal influence of the bays that are associated with Galveston Island and Bolivar Peninsula. The higher areas in this map unit are slightly convex, and the lower areas are slightly concave. Slight undulation occurs within short distances. The slopes range from about 0.3 to 1.5 percent. The mapped areas are irregular in shape and range from 5 acres to about 100 acres.

Mustang fine sand, slightly saline soil, makes up 40 to 65 percent of the map unit. Mustang fine sand, strongly saline soil, makes up 30 to 60 percent. Mustang, slightly saline, soil is in the slightly convex, higher parts of the map unit. Mustang strongly saline, soil is in the slightly concave lower part that is typified by a sparse vegetative cover. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Mustang fine sand, slightly saline, soil has a surface layer of dark grayish brown fine sand about 18 inches thick. The underlying material to a depth of 60 inches is fine sand that is grayish brown in the upper part and gray in the lower part. This soil is moderately alkaline throughout.

Typically, Mustang fine sand, strongly saline, soil has a surface layer of dark grayish brown fine sand about 6

inches thick. The underlying material to a depth of 60 inches is grayish brown fine sand. This soil is moderately alkaline throughout.

Included with these soils in mapping are areas of Follet, Karankawa, and Veston loam, strongly saline, soils. Follet and Karankawa soils are in slightly lower positions on the landscape than the soils in this complex, and Veston soil is in similar position as Mustang, strongly saline, soil.

The soils in this map unit are rapidly permeable above the high water table. The surface runoff is very slow. Mustang fine sand, strongly saline, soil is frequently flooded by abnormally high spring tides and by heavy rains and storm tides. Mustang fine sand, slightly saline, soil is occasionally flooded by storm tides. Mustang soil that is slightly saline has a high water table within 0.5 foot of the surface during most of the winter. Mustang soil that is strongly saline has a high water table at or near the surface most of the year.

The salinity varies according to the position of these soils on the landscape. Salt spray increases salinity in the surface layer of the slightly saline Mustang soil during the summer or during prolonged dry periods. The salt is readily leached from the surface during rainy periods. During dry periods in the summer, continued evaporation from the surface causes the salinity to increase dramatically on the surface of the strongly saline Mustang soil.

The soils in this complex are mainly used as rangeland. These soils are not suited to cropland or pastureland because of salinity. Flooding is a hazard.

The potential range forage yields of these soils are medium. Although the Mustang fine sand, slightly saline, soil is productive, the low productive capacity of Mustang fine sand, strongly saline, soil, decreases the overall forage production. Mustang, slightly saline, soil produces high yields of marsh range grasses. Mustang, strongly saline, soil produces only a sparsely vegetated plant community of low producing marsh range grasses and forbs that are not very palatable for livestock.

For most urban uses, the main limitations are wetness and salinity. The susceptibility to flooding and wind damage by hurricanes are hazards.

The soils in this complex are in capability subclass VIw. Mustang, slightly saline, soil is in the Low Coastal Sand range site. Mustang, strongly saline soil, is in the Salt Flat range site.

Mt—Mustang-Nass complex. This complex consists of gently undulating, poorly drained and very poorly drained, nonsaline to moderately saline, sandy soils. These soils are on a series of old, abandoned beach ridges and in wet swales that parallel the Gulf of Mexico. The slopes average about 2 percent but range from 0.5 to 3.0 percent. The mapped areas are irregular in shape and range from 40 acres to about 1,500 acres.

Mustang soil makes up 50 to 75 percent of the map unit. Nass soil makes up from 25 to 40 percent. Mustang soil is on the ridges. Nass soil is in the wet swales. The soils in this complex are so intricately mixed and some soil areas are so narrow and long that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Mustang soil has a surface layer that is dark grayish brown fine sand about 14 inches thick. The underlying material to a depth of 60 inches is light brownish gray fine sand. This soil is nonsaline and moderately alkaline throughout.

Typically, Nass soil has a surface layer that is slightly saline, very dark grayish brown loamy very fine sand about 4 inches thick that has a few shell fragments more than 2 millimeters in size. The next layer, to a depth of 15 inches, is slightly saline, grayish brown very fine sand. The underlying material to a depth of 60 inches is moderately saline, grayish brown very fine sand. This soil is moderately alkaline throughout.

Included with these soils in mapping are areas of Galveston, Karankawa, Mustang, strongly saline, soils. Also included is a soil that is similar to Nass soil that is loamy within 40 inches of the surface.

The soils in this complex are rapidly permeable above the high water table. The surface runoff is very slow on Mustang soil, and is very slow to ponded on Nass soil. Nass soil is occasionally flooded by storm tides and is frequently flooded by heavy rains. Mustang soil is occasionally flooded by storm tides.

Mustang soil has a high water table that is generally about 6 inches below the surface layer on the ridges. On Nass soil, the high water table is 6 to 24 inches above the surface in the center of the wet swales.

The salinity varies according to the position of these soils on the landscape. On the ridges and in the upper part of the side slopes, Mustang soil is nonsaline except during prolonged dry periods. Without adequate rainfall, the surface layer becomes slightly saline because of salt spray. The salt is readily leached from the soil during rainy periods. The lower part of the side slopes is slightly saline to moderately saline most of the year. In the swales, Nass soil is generally moderately saline; but, after a rain, it becomes slightly saline. This soil becomes extremely saline during periods of low rainfall in the summer. Typically, a narrow, sparsely vegetated strip is just above the swale. This strip is extremely saline most of the year.

The soils in this complex are mainly used as rangeland. In addition, Nass soil is used as habitat for a variety of wetland wildlife. The soils in this map unit are not suited to general cropland or pastureland because of plant exposure to salt spray. In addition, Nass soil is not suited to cropland or pastureland because of salinity and a high water table.

The potential range forage yields of the soils in this map unit are medium. The plant communities are not the

same on Mustang and Nass soils, and the soils are in different range sites. These differences require an understanding of grazing management and plant ecology to consistently obtain high yields. Other concerns in management of Nass soil involve the water table and the climatically induced plant community changes because of the excessive salinity caused by storm tides or by prolonged droughts.

Wetness and salinity are the main limitations to use of Nass soil for most urban uses. Flooding is a hazard on Mustang and Nass soil. Because of the proximity of these soils to the beaches of the Gulf of Mexico, they are often used as sites for weekend and summer cottages and for other related urban uses.

The soils in this complex are in capability subclass VIw. Mustang soil is in the Low Coastal Sand range site. Nass soil is in the Coastal Swale range site (fig. 9).

Mu—Mustang-Urban land complex. This complex consists of a nearly level, poorly drained, nonsaline, sandy soil and Urban land. These soils are in the coastal areas. They are mainly sandy material that was dredged from bay and canals. This material has been added to the surface of the original sandy soil. The slopes range from 0.2 to 0.8 percent. The mapped areas are irregular in shape and range from 10 acres to several hundred acres.

Mustang soil makes up 50 to 80 percent of the map unit. Urban land makes up from 20 to 40 percent. Mustang soil is in open lots, yards, and other open areas. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Mustang soil has a surface layer that is neutral, grayish brown fine sand about 18 inches thick. The

Figure 9.—In this complex, the soil in the lighter areas is Mustang soil in the Low Coastal Sand range site. The soil in the darker areas is Nass soil in the Coastal Swale range site.

upper part of the underlying material, to a depth of about 35 inches, is neutral, light brownish gray fine sand. The lower part to a depth of 60 inches is moderately alkaline, light gray fine sand. This soil is nonsaline throughout.

Urban land consists of soils that have been altered or covered by buildings or other urban structures making mapping impractical. Typically, these structures are single and multiple unit dwellings, garages, sidewalks, driveways, streets, shopping centers, office buildings, wharves, warehouses, railroad yards, and parking lots.

Included in mapping are areas of Galveston, Karankawa, and Nass soils. Also included are some areas of soils that are similar to Mustang soil that have loamy and clayey layers in the underlying material. Also some small landfills and excavated areas are included in mapping. Most of this map unit has had an average of 2 feet of sandy dredged material added to the original surface layer in the last 80 years.

The soils in this complex are rapidly permeable above the high water table. The surface runoff is very slow. The high water table is within 1 foot of the surface during most of the year. These soils are occasionally flooded by storm tides. They are nonsaline most of the year except during prolonged dry periods. During these dry periods, the surface layer becomes slightly saline because of the salt spray. The salt is readily leached from the soil by rain. This soil is also susceptible to wind erosion if it is left unprotected after being disturbed.

For most urban uses, the main limitation is wetness. The susceptibility to flooding by storm tides, wind damage by hurricanes, and the susceptibility to wind erosion if the soil is left unprotected for long periods are severe hazards. Because of the proximity of these soils to the beaches of the Gulf of Mexico, they are often used as sites for weekend and summer cottages and for other related urban uses.

The soils in this complex have not been assigned to a capability subclass or to a range site.

Na—Narta fine sandy loam. This is a nearly level, somewhat poorly drained, moderately saline, loamy soil that has a clayey subsoil. It is on the uplands that border the coastal marsh. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 5 acres to about 1,000 acres.

Typically, this soil has a surface layer that is moderately saline, mildly alkaline, dark gray fine sandy loam about 9 inches thick. The upper part of the subsoil, to a depth of 14 inches, is very dark gray clay. The middle part, to a depth of 38 inches, is gray clay. The lower part to a depth of 60 inches is light gray clay. This soil is moderately saline and moderately alkaline throughout the subsoil.

Included with this soil in mapping are small areas of Bernard, Edna, Francitas, and Placedo soils. Bernard and Edna soils are in slightly higher positions on the landscape than Narta soil. Francitas soils are in similar positions. Placedo soils are in slightly lower positions. The included soils make up less than 20 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded by heavy rains and storm tides. The high water table is within 1 foot of the surface during most of the winter.

This Narta soil is used as rangeland and as habitat for wildlife. This soil is not suited to crop production or to pastureland because of salinity.

This soil produces high yields of marsh range grasses. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning can be effectively used to maintain plant vigor. This Narta soil is in pasture in the higher positions near the marsh. These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the main limitations are wetness, high shrink-swell potential, and salinity. The susceptibility to flooding by storm tides is a hazard.

This Narta soil is in capability subclass VIs. It is in the Salty Prairie range site.

Ns—Nass very fine sandy loam. This is a nearly level, very poorly drained, slightly saline to strongly saline, sandy soil. It is in the enclosed depressional coastal areas that parallel the coastline. The surface is concave. The slopes average about 0.3 percent. The mapped areas are circular to elongated and range from 10 acres to about a hundred acres.

Typically, this soil has a surface layer that is slightly saline, mildly alkaline, dark gray very fine sandy loam about 27 inches thick. The upper part of the underlying material, to a depth of 44 inches, is moderately saline, gray loamy very fine sand. The middle part, to a depth of 57 inches, is strongly saline, dark grayish brown very fine sand. The lower part of the underlying material to a depth of 65 inches is strongly saline, gray very fine sand. Reaction is moderately alkaline throughout the underlying material.

Included with this soil in mapping are small areas of Mustang and Karankawa soils. Mustang soils are in higher positions on the landscape than Nass soil. Karankawa soils are in lower positions. Also included is a soil that is similar to Nass soil that is loamy throughout. The included soils make up less than 20 percent of the map unit.

This soil is rapidly permeable above the high water table. The surface runoff is very slow, or the soil is ponded. Most of the time, the high water table is near the surface or up to 2 feet of water stands on the surface. This soil is occasionally flooded by storm tides

and heavy rains. A few areas of this soil are frequently flooded.

Salinity varies according to the season of the year and the position of the soil on the landscape. Generally, the upper part of the soil becomes slightly saline to moderately saline during the winter but is strongly saline during dry periods in the summer. Generally, a soil that is more saline has been exposed to more frequent tidal inundation or has a permanent high water table at or below the surface.

This Nass soil is used as rangeland. It is also used as habitat for wildlife and is used by a variety of wetland wildlife. This soil is not suited to cropland or pastureland because of salinity and wetness.

The potential range forage yields of this soil are medium. Plants in the native plant community are generally less palatable and less productive than those in other areas. Other concerns in management involve the high water table and the climatically induced plant community changes because of excessive salinity, which is caused by storm tides, or because of prolonged droughts. Generally, only the edges of this area are easily accessible to livestock; therefore, livestock use is limited.

For most urban uses, the main limitations are wetness and salinity. The susceptibility to flooding by storm tides and wind damage by hurricanes are severe hazards. Because of the proximity of this soil to the beaches of the Gulf of Mexico, it is sometimes used as sites for weekend and summer cottages (fig. 10).

This Nass soil is in capability subclass VIIw. It is in the Coastal Swale range site.

Nx—Nass-Galveston complex, shell substratum. This complex consists of gently undulating, very poorly drained and somewhat excessively drained, nonsaline to moderately saline, sandy soils that have a sandy subsoil. These soils are in the coastal areas. They are on a series of old, abandoned beach ridges and in wet swales that parallel the Gulf of Mexico. The slopes average about 2.5 percent but range from 0.5 to 4.0 percent. The mapped areas are irregular in shape and range from 40 acres to about 200 acres.

Nass soil makes up 30 to 60 percent of the map unit. Galveston soil makes up 20 to 45 percent, and a soil that is included with Nass and Galveston soils in mapping but is similar to Mustang soils makes up 20 to 40 percent. Nass soil is in the wet swales. Galveston soil is on the upper part of the ridges. The soil that is included with these soils in mapping but is similar to Mustang soils and contains many shell fragments is on the lower part of the ridges. The soils in this complex are so intricately mixed and some soil areas are so narrow and long that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Nass soil has a surface layer that is black loamy very fine sand about 10 inches thick that has a few shell fragments up to 10 millimeters in size. The underlying material to a depth of 60 inches is dark gray loamy fine sand that has about 20 percent shell fragments more than 2 millimeters in size. This soil is moderately saline, moderately alkaline throughout.

Typically, Galveston soil has a surface layer that is very dark gray fine sand about 11 inches thick that has a few shell fragments more than 2 millimeters in size. The underlying material to a depth of 60 inches is grayish brown sand that has about 20 percent shell fragments more than 2 millimeters in size. This soil is nonsaline and moderately alkaline throughout.

Included with these soils in mapping is Karankawa soils. Also included is a soil that is similar to Nass soil that is loamy within 40 inches of the surface.

The soils in this complex are rapidly permeable above the high water table. The surface runoff is very slow to ponded on Nass soil, and it is very slow on Galveston soil. Nass soil and Galveston soil are occasionally flooded by storm tides. Nass soil also is frequently flooded by heavy rains.

On Galveston soil, the high water table is typically at a depth of about 50 inches on the high ridges. On Nass soil, it is 6 to 24 inches above the surface in the center of the wet swales.

The salinity varies according to the position of these soils on the landscape. On the ridges and in the upper part of the side slopes, Galveston soil is nonsaline except during prolonged dry periods. Without adequate rainfall, the surface layer becomes slightly saline because of salt spray. The salt is readily leached from the soil during rainy periods. The lower part of the side slopes is slightly saline to moderately saline most of the year. In the swales, Nass soil is generally moderately saline, but after a rain, it becomes slightly saline. This soil becomes extremely saline during periods of low rainfall in the summer. Typically, a narrow, sparsely vegetated strip is just above the swale. This strip is extremely saline most of the year.

The soils in this complex are mainly used as rangeland. In addition, Nass soil is used as habitat for a variety of wetland wildlife. The soils in this map unit are not suited to general cropland or pastureland because of plant exposure to salt spray. In addition, these soils are not suited to cropland or pastureland because of salinity and high water table on Nass soil and because of the droughtiness of Galveston soil. A few speciality crops and pasture grasses are adapted to the Galveston soils; but because these areas occur in long, narrow strips, crop production is not economical.

The potential range forage yields of the soils in this complex are medium. The plant communities are not the same on Nass and Galveston soils, and the soils are in different range sites. These differences require an understanding of grazing management and plant ecology to consistently obtain high yields. Other concerns in management of Nass soil involve the high water table

Figure 10.—This beach house is under construction on Nass very fine sandy loam. Soil material is being added to raise the soil surface above the high water table.

and the climatically induced plant community changes because of the excessive salinity, which is caused by storm tides, or because of prolonged droughts.

Wetness and salinity are the main limitations to use of Nass soil for most urban uses. The susceptibility to flooding and wind damage from hurricanes are hazards on the Nass and Galveston soils, and the susceptibility to wind erosion when the soil is left unprotected for long periods is an additional hazard on Galveston soil. Because of the proximity of these soils to the beaches of the Gulf of Mexico, they are often used as sites for weekend and summer cottages and for other related urban uses.

The soils in this complex are in capability subclass VIw. Nass soil is in the Coastal Swale range site. Galveston soil is in the Low Coastal Sand range site.

Pa—Pits, sand. Pits is an area from which sand has been mined. It is mainly in areas of Aris soil. The mapped areas range from 4 acres to about 200 acres.

Pits is not suitable for farming. Some of the abandoned areas can be reclaimed and used as habitat for wildlife or for water storage.

Pits has not been assigned to a capability subclass or to a range site.

Pd—Placedo clay. This is a nearly level, very poorly drained, saline, clayey soil that has a clayey subsoil. It is in the coastal marshes. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 10 acres to several hundred acres.

Typically, this soil has a surface layer that is 28 inches thick. It is dark gray clay in the upper part and grades to gray clay in the lower part. The upper part of the underlying material, to a depth of 36 inches, is light gray clay. The lower part to a depth of 60 inches is light gray sandy clay. This soil is strongly saline and moderately alkaline throughout.

Included with this soil in mapping are small areas of Follet, Francitas, Harris, Tatlum, Tracosa, and Veston soils. Francitas soils are in slightly higher positions on the landscape than Placedo soil; Follet, Tatlum, Tracosa, and Veston soils are in slightly lower positions; and Harris soils are in similar positions. The included soils make up less than 15 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is frequently flooded by heavy rains, unusually high spring tides, and storm tides. The high water table is at or near the surface most of the year.

This soil is mainly used as rangeland and as habitat for wildlife. It is not suited to crop production or pastureland because of salinity and flooding. This soil is used extensively by many of the wetland wildlife game species.

This soil is capable of producing high yields of marsh range grasses when properly managed. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be effectively used to maintain plant vigor.

For most urban uses, the main limitations are wetness, salinity, clayey texture, and low strength. Flooding is a hazard.

This Placedo soil is in capability subclass VIIw. It is in the Salt Marsh range site.

Sa—Sabine loamy fine sand. This is a gently undulating, somewhat excessively drained, nonsaline, sandy soil. It is in the coastal areas and is on the old, abandoned beach ridges. The slopes range from 0.2 to 1 percent. The mapped areas are generally oblong and range from 10 acres to several hundred acres.

Typically, this soil has a surface layer that is slightly acid, very dark grayish brown loamy fine sand about 14 inches thick. The upper part of the underlying material, to a depth of 30 inches, is slightly acid, brown fine sand. The middle part, to a depth of 60 inches, is neutral, light brownish gray loamy fine sand. The lower part to a depth of 75 inches is moderately alkaline, light gray fine sand. This soil is nonsaline throughout.

Included with this soil in mapping are small areas of Galveston, Mustang, and Nass soils. Galveston soil is in similar positions on the landscape as Sabine soil. Mustang and Nass soils are in lower positions. The included soils make up less than 10 percent of the map unit.

This soil is rapidly permeable above the high water table. The surface runoff is very slow. The high water table is at a depth of 2.5 to 4 feet. This soil is rarely flooded by storm tides and hurricanes. It is nonsaline most of the year except during prolonged dry periods. Without adequate rainfall, the surface layer becomes slightly saline because of salt spray. The salt is readily leached from the soil during rainy periods. This soil is also susceptible to wind erosion if it is left unprotected after being disturbed.

This Sabine soil is mainly used as rangeland or pastureland. A few areas are used for speciality crops. This soil is not suited to general cropland or pastureland because of plant exposure to salt spray and sandy texture.

This soil is suited to specific truck crops that can tolerate salt spray. Because of its low available water capacity, this soil is droughty. Incorporating crop residue in the surface layer improves the available water capacity and reduces soil loss by wind and water erosion.

This soil is suited to only certain pasture grasses that can withstand salt spray and the droughtiness of the soil. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil produces high yields when properly managed. Plant vigor should be maintained by proper stocking and rotating grazing. Prescribed burning also can be effectively used to help maintain plant vigor. This Sabine soil is in pastures in the higher positions near the marsh. These areas are dryer than nearby soils and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. The plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the susceptibility to flooding by storm tides, wind damage by hurricanes, and the susceptibility to wind erosion when the soil is left unprotected for long periods are severe hazards. Because of the proximity of this soil to the beaches of the Gulf of Mexico, it is used as sites for weekend and summer cottages and for other related urban uses.

This Sabine soil is in capability subclass IIIs. It is in the Coastal Sand range site.

SeB—Sievers loam, 0 to 3 percent slopes. This is a nearly level to gently sloping, somewhat poorly drained, moderately saline, loamy soil that has a loamy subsoil. It

is in the coastal marshes. This soil formed from loamy materials dredged from canals, ditches, and waterways. The slopes average about 1 percent. The mapped areas are long and narrow in shape and range from 10 acres to several hundred acres.

Typically, this soil has a surface layer that is grayish brown loam about 12 inches thick. The upper part of the underlying material, to a depth of 15 inches, is dark grayish brown stratified loam. The next layer, to a depth of 24 inches, is mottled dark grayish brown, light gray, and brown stratified clay loam. The next layer, to a depth of 30 inches, is gray stratified loam. The next layer, to a depth of 45 inches, is light gray loam. The lower part to a depth of 60 inches is mottled light brownish gray and dark grayish brown stratified loam and fine sandy loam. This soil is moderately alkaline and moderately saline throughout.

Included with this soil in mapping are small oyster shell beds and small areas that are sandy and less saline throughout than Sievers soil. Also included are some areas that have more clayey strata that are extremely saline. The included soils make up less than 25 percent of the map unit.

This soil is moderately slowly permeable above the high water table. The surface runoff is slow. This soil is rarely flooded by storm tides. The high water table is at a depth of about 2.5 to 4 feet during most of the winter. Areas where dredged material has just been added can remain boggy for several years. Although the soil is generally moderately saline, salinity is dependent on the original salinity of the dredged material and the length of time that the dredged material has been laid down. Salt is not readily leached through the soil.

This Sievers soil is mainly used as habitat for wildlife and as rangeland. It is not suited to crop production or pasture because of salinity.

This soil will produce high yields of marsh range grasses. In areas where dredged material has just been added, the plant community will not be stable for many years. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be effectively used to maintain plant vigor. This Sievers soil is in pastures in the higher positions in the marsh. These areas are dry and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the main limitations are wetness and salinity. Flooding is a hazard.

This Sievers soil is in capability subclass VIw. It is in the Salty Prairie range site.

StA—Stowell-Leton complex, 0 to 2 percent slopes. This complex consists of nearly level to gently sloping, somewhat poorly drained and poorly drained, nonsaline, sandy and loamy soils that have a loamy subsoil. These soils are on the uplands. This map unit is 50 to 70 percent low ridges and 20 to 35 percent depressions that range from circular to oblong. The slopes average about 0.6 percent. The mapped areas are oblong and average a few hundred acres.

Stowell soil makes up 50 to 70 percent of the map unit. It is on the low ridges. The Leton makes up 20 to 35 percent of the unit. It is in the depressional areas. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Typically, Stowell soil has a surface layer that is very dark grayish brown loamy fine sand about 16 inches thick. The subsurface layer, to a depth of 26 inches, is light gray fine sand. The upper part of the subsoil, to a depth of 58 inches, is light brownish gray sandy clay loam. The lower part to a depth of 62 inches is light gray sandy clay loam. Reaction is strongly acid in the surface and subsurface layers and is medium acid throughout the subsoil.

Typically, Leton soil has a surface layer and subsurface layer that is neutral, loam about 13 inches thick. It is dark gray in the upper part and grayish brown in the lower part. The upper part of the subsoil, to a depth of 30 inches, is mildly alkaline, light brownish gray sandy clay loam that has tongues of loam. The lower part to a depth of 60 inches is moderately alkaline, gray sandy clay loam.

Included with these soils in mapping is a soil similar to Stowell soil but that has a surface layer of a lighter color and a sandy subsoil. Also included is a soil similar to Leton soil that has a sandy subsoil.

The permeability of Stowell soil is moderately rapid above the water table, and the permeability of the Leton soil is slow above the water table. The surface runoff of the soils in this map unit is very slow to ponded. These soils are rarely flooded by heavy rain. The high water table is at a depth of 1.5 to 4 feet in Stowell soil, and it is at the surface to a depth of 1.5 feet in Leton soil in winter and spring.

The soils in this complex are mainly used as pastureland. Some areas are used as rangeland.

These soils are poorly suited to crops. They are not suited to rice production because the soils are too permeable and too undulating. A well designed surface water management system that includes proper row direction and drainage in the depressional areas is an important factor for crop production. Some of the more sloping soils in this map unit are susceptible to erosion if they are left unprotected. Leton soil typically remains wet for long periods after a rain, which hampers the timely scheduling of farming operations.

These soils are moderately suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water and to increase the production of pasture grasses. A grazing

management system that includes fertilization increases forage yield and improves quality.

The potential range forage yields of the soils in this complex are medium. The overall production is lowered because of the depressional areas that are less productive and that produce forbs and grasses that are not very palatable for livestock.

For most urban uses, the main limitation is wetness.

The soils in this complex are in capability subclass IVw. Stowell soil is in the Loamy Prairie range site. Leton soil is in the Lowland range site.

Ta—Tatlum mucky clay loam. This is a nearly level, very poorly drained, saline, loamy soil. It is in the tidal marshes. The slope averages about 0.1 percent. The mapped areas are irregular in shape and range from 20 acres to a few hundred acres.

Typically, this soil has a surface layer that is gray mucky clay loam about 12 inches thick. The upper part of the underlying material, to a depth of 38 inches, is light gray mucky clay loam. The lower part to a depth of 60 inches is light gray stratified fine sandy loam. This soil is strongly saline and moderately alkaline throughout.

Included with this soil in mapping are small areas of Caplen, Follet, Mustang, Tracosa, and Veston soils. Caplen, Mustang and Veston soils are in higher positions on the landscape than Tatlum soil, and Follet and Tracosa soils are in similar positions. The included soils make up less than 20 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. The permanent high water table allows very little water movement through the soil. This soil remains saturated throughout the year. It is flooded with 2 to 12 inches of tidal water at some time during the day, and it is frequently flooded by spring tides, storm tides, and heavy rains.

This Tatlum soil is mainly used as habitat for wildlife. It is not suited to crop production or pastureland because of wetness, flooding, and salinity. This Tatlum soil is used extensively by nongame wetland wildlife and is an important part of the marine estuarine system.

This soil is capable of producing high yields of native range grasses, but it is generally not suited to livestock grazing because the soil can not support the weight of livestock.

For most urban uses, the main limitations are low strength, wetness, and salinity. Flooding is a hazard.

This Tatlum soil is in capability subclass VIIIw. It is in the Tidal Flat range site.

Tc—Tracosa clay, low. This is a nearly level, very poorly drained, saline, clayey soil that has a clayey subsoil. It is in broad, tidal marshes. This map unit is essentially barren. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from about 500 acres to 1,000 acres.

Typically, this soil is clay to a depth of about 60 inches that is dark gray in the upper part and gray in the lower part. It is moderately alkaline throughout.

Included with this soil in mapping are small areas of Follet, Placedo, and Tatlum soils. Follet and Tatlum soils are in similar positions on the landscape as Tracosa soil, and Placedo soils are in slightly higher positions. The included soils make up less than 10 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil remains saturated throughout the year. It is covered daily with 2 to 12 inches of water during high tide and is frequently flooded by spring tides, heavy rains, and storm tides.

This soil is used as habitat for wildlife. It is not suited to crop production or pastureland because vegetation is scarce and because of wetness, flooding, and salinity. This area of Tracosa soil is used some by nongame wetland wildlife and is an important part of the marine estuarine system.

Although this soil is barren, it has the potential to produce native range grasses (fig. 11). There is some evidence of a plant community of salt-tolerant grasses growing on the soils in these areas in the past. Barren areas have no potential for livestock use.

For most urban uses, the main limitations are wetness, clayey texture, and salinity. Flooding is a hazard.

This Tracosa soil is in capability subclass VIIw. It has not been assigned to a range site; but, if areas of this soil become vegetated, management would be similar to that of the Tracosa mucky clay soil in the Tidal Flat range site.

Tm—Tracosa mucky clay. This is a nearly level, very poorly drained, saline, clayey soil that has a clayey subsoil. It is in tidal marshes. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 20 acres to several hundred acres.

Typically, this soil has a surface layer that is dark gray mucky clay about 12 inches thick. The upper part of the underlying material, to a depth of about 18 inches, is dark gray clay. The middle part, to a depth of 45 inches, is gray clay. The lower part to a depth of 60 inches is light gray clay. This soil is strongly saline and moderately alkaline throughout.

Included with this soil in mapping are small areas of Follet, Karankawa, and Tatlum soils. These soils are in similar positions on the landscape as Tracosa soil. The included soils make up less than 20 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil remains saturated throughout the year. It is flooded daily with 2 to 12 inches of water during high tide and is frequently flooded by spring tides, heavy rains, and storm tides.

This soil is used as habitat for wildlife. It is not suited to crop production or pastureland because of wetness,

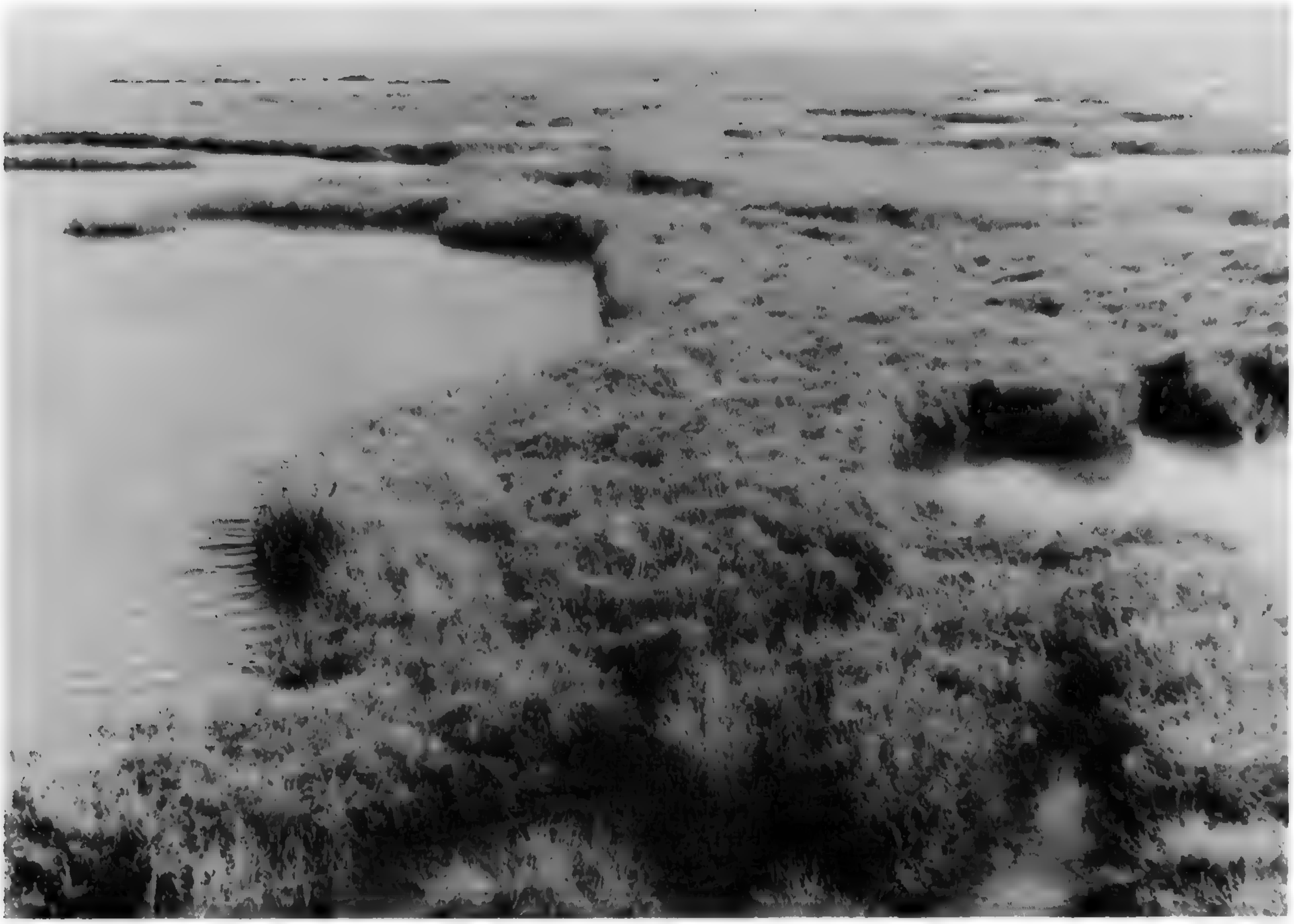


Figure 11.—These vegetated areas interspersed with water are on Tracosa clay, low, soil.

flooding, and salinity. This Tracosa soil is used extensively by nongame wetland wildlife and is an important part of the marine estuarine system.

This soil is capable of producing high yields of marsh range grasses. However, this marsh soil is seldom used as rangeland because it is boggy, inundated by tides, and does not have available freshwater and bedding areas. Management of these areas is difficult.

For most urban uses, the main limitations are wetness and salinity. Flooding is a hazard.

This Tracosa soil is in capability subclass VIIw. It is in the Tidal Flat range site.

Tx—Tracosa mucky clay-clay, low complex. This complex consists of nearly level, very poorly drained to ponded, saline, clayey soils that have a clayey subsoil. These soils are in broad, tidal marshes. Although the overall surface is plane, it is 20 to 40 percent depressional areas that are barren. The depressions are about 0.3 of a foot deep and are up to 100 feet across. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 10 acres to about 1,000 acres.

The Tracosa mucky clay part of this complex makes up 40 to 80 percent of the map unit. The Tracosa clay, low, part that is barren makes up 20 to 40 percent. Small bodies of permanent water make up as much as 15 percent. The mucky clay part is in the plane areas. The clay part is in the depressional areas that contain water most of the year. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale selected for mapping.

Typically, this soil has a surface layer that is dark gray mucky clay about 8 inches thick in the vegetated areas

and has a surface layer that is dark gray clay about 4 inches thick in the low areas. The underlying material to a depth of 60 inches is dark gray and gray clay. This soil is strongly saline and moderately alkaline throughout.

Included with these soils in mapping are areas of Follet soils that are in similar positions on the landscape as Tracosa soils.

The soils in this complex are very slowly permeable. The surface runoff is very slow. These soils are frequently flooded by spring tides, heavy rains, and storm tides. These soils remain saturated throughout the year. They are flooded daily by 2 to 12 inches of tidal water during high tide.

This complex is mainly used as habitat for wildlife. It is not suitable for crop production or pastureland because of wetness, flooding, and salinity. This complex is used extensively by nongame wetland wildlife and is an important part of the marine estuarine system.

Although the vegetated areas of the Tracosa soil produces high yields of marsh grasses, the overall production is lowered because of the barren depressional areas. However, this marsh soil is seldom used as rangeland because it is boggy, inundated by the tides, and does not have available freshwater and bedding areas. Management of these areas is difficult.

For most urban uses, the main limitations are wetness, clayey texture, and salinity. Flooding is a hazard.

The soils in this complex are in capability subclass VIIw. These soils are in the Tidal Flat range site.

Va—Vamont clay. This is a nearly level, somewhat poorly drained, nonsaline, clayey soil that has a clayey subsoil. It is on broad uplands. The slopes average about 0.1 percent. The mapped areas are irregular in shape and range from 5 acres to several hundred acres.

Typically, this soil has a surface layer that is medium acid, dark grayish brown clay about 6 inches thick. The upper part of the subsoil, to a depth of 43 inches, is medium acid grayish brown clay. The middle part, to a depth of 43 inches, is light brownish gray clay. The lower part to a depth of 62 inches is neutral, light gray clay.

Included with this soil in mapping are small areas of Bacliff, Bernard, Edna, Lake Charles, and Verland soils. Bacliff soils are in slightly lower positions on the landscape than Vamont soil; Bernard, Edna, and Verland soils are in slightly higher positions; and Lake Charles soils are in similar positions. Also included is a soil that is similar to Vamont soil but the subsoil is more brown. The included soils make up less than 20 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded. The high water table is within 1.5 feet of the surface during most of the winter.

This Vamont soil is mainly used as pastureland or cropland. The main crops are rice and soybeans. Some grain sorghum also is grown. Some areas are heavily wooded.

This soil is well suited to crops. It is also well suited to rice production because it is very slowly permeable, level, and requires little smoothing to flood it evenly. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. Because the soil has a clayey surface layer, it is difficult to till when dry; and when dry, it develops large cracks. In this condition, water readily enters the soil, and as the soil becomes moist, the cracks seal and water movement through the soil is very slow. Incorporating crop residue in the surface layer helps maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness, clayey texture, and high shrink-swell potential of the soil.

This Vamont soil is in capability subclass IIIw. It is in the Blackland range site.

Ve—Verland silty clay loam. This is a nearly level, somewhat poorly drained, nonsaline, loamy soil that has a clayey subsoil. It is on the uplands. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 5 acres to about 1,000 acres.

Typically, this soil has a surface layer that is slightly acid, dark gray silty clay loam about 6 inches thick. The upper part of the subsoil, to a depth of 30 inches, is medium acid, gray clay. The middle part to a depth of 52 inches, is mildly alkaline, light gray clay. The lower part to a depth of 60 inches is moderately alkaline, light gray clay.

Included with this soil in mapping are small areas of Bacliff, Bernard, Edna, Lake Charles, Mocarey, and Morey soils. Bacliff and Lake Charles soils are in slightly lower positions on the landscape than Verland soil; Bernard, Mocarey, and Morey soils are in similar positions; and Edna soils are in slightly higher positions. Also included is a soil that is similar to Verland soil that is red in the upper part of the subsoil. The included soils make up less than 15 percent of the map unit.

This soil is very slowly permeable. The surface runoff is very slow. This soil is rarely flooded. It has a high water table within 1.5 feet of the surface during most of the winter.

This Verland soil is mainly used as cropland. Some areas are used as pastureland. The main crops include rice and soybeans. Some grain sorghum also is grown.

This soil is well suited to crops. It is also well suited to rice production because it is very slowly permeable, level, and requires little smoothing to flood it evenly. A well designed surface water management system that includes proper row direction, drainage, leveling, and irrigation water management is an important factor for crop production. Incorporating crop residue in the surface layer helps to maintain good tilth. A well planned fertilizer program is essential to obtain high yields.

This soil is well suited to pasture grasses. A system of field drains that has adequate outlets is needed to remove excess surface water. A grazing management system that includes fertilization increases forage yields and improves quality.

This soil is capable of producing high yields of native range grasses when properly managed.

For most urban uses, the main limitations are wetness and high shrink-swell potential of the soil.

This Verland soil is in capability subclass IIIw. It is in the Blackland range site.

Vn—Veston loam, moderately saline. This is a nearly level, poorly drained, saline, loamy soil that has a loamy subsoil. It is on the coastal flats and on narrow, convex ridges in the coastal marshes. The slopes average about 0.3 percent. The mapped areas are irregular in shape and range from 10 acres to a few hundred acres.

Typically, this soil has a surface layer that is mildly alkaline dark gray loam about 13 inches thick. The underlying material, to a depth of 60 inches, is mildly alkaline, gray stratified loam and clay loam. The lower part to a depth of 68 inches is moderately alkaline, gray sandy loam. This soil is moderately saline throughout.

Included with this soil in mapping are small areas of Follet, Mustang, and Narta soils. Follet soils are in slightly lower positions on the landscape than Veston soil, and Mustang and Narta soils are in slightly higher positions. The included soils make up less than 15 percent of the map unit.

This soil is slowly permeable. The surface runoff is very slow. A high water table is at a depth of 1 foot to 2 feet during most of the year. This soil is occasionally flooded by heavy rains and storm tides.

This Veston soil is mainly used as rangeland and as habitat for wildlife. It is not suited to crop and pasture production because of salinity.

This soil will produce high yields of marsh range grasses. Plant vigor can be maintained by proper stocking and by using a grazing rotation system. Prescribed burning also can be used to help maintain plant vigor. This Veston soil is in pastures in the higher positions in the marsh. These areas are dry and are used extensively by cattle as bedding areas and as a refuge during abnormally high tides. Therefore, the plants in these areas generally are overgrazed while the plants in the lower positions in the marsh are lightly grazed. Management of these areas is difficult.

For most urban uses, the main limitations are wetness and salinity. Flooding is a hazard.

This Veston soil is in capability subclass VIw. It is in the Salty Prairie range site.

Vs—Veston loam, strongly saline. This is a nearly level, poorly drained, saline, loamy soil that has a loamy subsoil. It is in the coastal marshes. The slopes average about 0.2 percent. The mapped areas are irregular in shape and range from 10 acres to a few hundred acres.

Typically, this soil has a surface layer that is moderately alkaline, strongly saline, dark gray loam about 10 inches thick. The upper part of the underlying material, to a depth of 28 inches, is moderately alkaline, strongly saline, gray clay loam. The lower part to a depth of 60 inches is moderately alkaline, strongly saline, light brownish gray clay loam.

Included with this soil in mapping are small areas of Harris, Follet, Placedo, and other Veston soils. Harris, Follet, and Placedo soils are in slightly lower positions on the landscape than Veston soil. Also included are some Veston soils that are in slightly higher positions and are less saline. The included soils make up less than 15 percent of the map unit.

This soil is slowly permeable above the high water table. The surface runoff is very slow. This soil is frequently flooded by unusually high spring tides and storm tides. The high water table is within 10 inches of the surface most of the year.

This Veston soil is mainly used as habitat for wildlife. Some acreage is used as rangeland. This soil is not suitable for crop production or pastureland because of salinity and wetness. Flooding is a hazard.

This soil is capable of producing high yields of marsh range grasses when properly managed. Plant vigor can be maintained by proper stocking and, if possible, by using a grazing rotation system. Prescribed burning also can be effectively used to help maintain plant vigor.

For most urban uses, the main limitations are wetness and salinity. Flooding is a hazard.

This Veston soil is in capability subclass VIIs. It is in the Salt Marsh range site.

Vx—Veston loam, slightly saline-strongly saline complex. This complex consists of nearly level, poorly drained, saline, loamy soils that have a loamy subsoil. They are on the coastal marsh flats. This map unit is a complex of salinity phases. The overall slope is about 0.2 percent, but it is irregular or slightly undulating within short distances. The mapped areas are irregular in shape and range from 10 acres to several hundred acres.

Typically, the surface layer is dark gray loam about 10 inches thick. The upper part of the underlying material, to a depth of 28 inches, is gray loam. The middle part, to

a depth of 60 inches, is light gray stratified clay loam. The lower part to a depth of 65 inches is bluish gray clay. The soils in this complex are moderately alkaline throughout.

The salinity of the soils in this complex ranges from slight to very strong, depending on the position on the landscape. The slightly saline areas of this map unit make up about 30 percent and are in the highest parts of the landscape. The strongly saline areas make up about 35 percent and are in the lowest parts of the landscape. The very strongly saline areas make up about 35 percent and are intermediate in landscape position between the slightly saline areas and the strongly saline areas where capillary moisture concentrates salts on the surface of these soils. The soils in this complex are so intricately mixed that it is not practical to separate them at the scale used for the maps in the back of this publication.

Included with this soil in mapping are small areas of Follet, Mustang, and Placedo soils. Follet and Placedo soils are in slightly lower positions on the landscape than these Veston soils, and Mustang soils are in slightly higher positions. Also included are small areas of Veston loam soils that are moderately saline. The included soils make up less than 15 percent of the map unit.

The soils in this complex are slowly permeable. The surface runoff is very slow. These soils are frequently flooded by storm tides. The water table is within 2 feet of the surface most of the year in the slightly saline areas of this complex and is at the surface in the strongly saline areas.

The soils in this complex are mainly used as habitat for wildlife. Some areas are used as rangeland. These soils are not suitable for crop production or pastureland because of salinity and wetness. Flooding is a hazard.

Although the soils in this complex produce high yields of several marsh grasses in small areas, the overall production is decreased because of the low production and low quality grasses and forbs in the barren areas in the complex. Plant vigor can be maintained by proper stocking and using a grazing rotation system if possible. Prescribed burning also can be effectively used to help maintain plant vigor.

The soils in this complex are in capability subclass VIIs. Veston loam, slightly saline, soil is in the Salty Prairie range site. Veston loam, strongly saline, soil is in the Salt Marsh range site.

Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Galveston County are listed in table 5.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 5 percent.

Recent trends in land use in the survey area have resulted in the loss of many prime farmland soils to urban and industrial uses. The loss of these prime farmland soils to other uses puts pressure on marginal lands, which generally are more difficult to cultivate, less productive, and more expensive to farm.

About 98,140 acres, or more than 38 percent, of the soils in Galveston County meet the requirements for prime farmland soils. An additional 23,520 acres, or more than 9 percent, meet the requirements if they have adequate drainage; therefore, in Galveston County more than 47 percent of the soils can qualify as prime farmland. Areas are scattered throughout the mainland part of Galveston County. General soil map units 1, 2, 3, and 5 contain most of the prime farmland soils in the county.

The following map units, or soils, make up prime farmland in Galveston County. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This information does not constitute a recommendation for a particular land use.

Soils that have limitations, such as a high water table or flooding, may qualify as prime farmland if these limitations are overcome by such measures as drainage or flood control. In table 5, the measures needed to overcome the limitations of a map unit, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to determine if the limitations have been overcome by the corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern that is in harmony with nature.

Contractors can use this survey to locate sources of sand, roadfill, and topsoil. They can use it to identify areas where wetness or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Tommy E. Wilson, soil conservationist, Soil Conservation Service, assisted in the preparation of this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 255,361 acres of land area is in the county. According to the local Soil Conservation Service, about 33,000 acres is in permanent pasture; 10,000 acres in row crops, which include crops, such as grain sorghum and soybeans; and 5,500 acres in rice. The remaining acreage includes about 123,461 acres of urban or built-up land, 62,000 acres of rangeland, and 21,400 acres of idle cropland.

The soils in Galveston County have good potential for the production of food. About 5,000 acres of potentially good cropland is used as upland rangeland, and about 32,000 acres is used for pasture. In addition to this potential for cropland, food production can be increased by using the latest technology. This soil survey can help facilitate the application of this technology.

Acreage in crops and pasture is steadily decreasing as more and more land is converted to urban and industrial uses. Some land is left idle. This idle land is being held primarily for future urban uses. The use of this soil survey to help make land use decisions that will influence the future role of farming in the survey area is discussed in the section "General Soil Map Units."

Surface drainage of cropland and pastureland in Galveston County is a major concern in management. Because nearly all of the soils used for cropland and pastureland are somewhat poorly drained or poorly drained and the slopes mostly are nearly level, these soils remain wet for long periods. This wetness is detrimental to plant growth. Some areas have drainage systems that remove excess surface water quickly. In other places, the outlets are inadequate, and drainage systems are expensive to improve and difficult to install.

Preparing a good seedbed is somewhat difficult on clayey soils, such as Lake Charles and Bacliff soils. However, if farmers recognize this problem, it can be dealt with effectively.

Maintaining soil tilth is an important factor for the germination of seed and infiltration of water into the soil. The soil surface should be granular and porous. The

clayey soils are generally dense; and to make a good seedbed, these soils need to be tilled more than loamy soils. In some of the loamy soils, the aggregates tend to disperse during rainfall and seal over. This increases runoff and reduces the rate of water infiltration. Plowing crop residue into the soil improves soil structure and tilth.

Generally, soil erosion is not a major problem because nearly all cropland is on nearly level soils. Normally, soil loss is within the allowable limits if proper tillage practices are used.

Specialty crops that are grown commercially in the survey area include a variety of vegetable crops, such as onions and mustard greens. They are grown mostly on loamy soils, such as Aris, Kemah, and Mocarey soils. The main orchard crop is pecans. Pecans are adapted to many of the soils in the county but are more suited to the better drained soils.

The latest information and suggestions for growing specialty crops can be obtained from the local offices of the Cooperative Extension Service and the Soil Conservation Service.

Management of Cultivated Crops

The major concerns in management when using the soils for cultivated crops are described in this section. In addition, the crops best adapted to the soils in the survey area are discussed.

In Galveston County, the kind of management and the intensity needed vary with the kind of soil and the type of farming. Drainage and maintaining soil tilth and fertility are the main management concerns. The runoff of excess surface water on many soils is very slow because most areas that are suitable for cropland are flat to nearly level and have slow to very slow permeability. Therefore, without an adequate field drainage system, these soils are wet for significant periods following rains. A properly installed drainage system removes the excess surface water so that land treatment practices needed to increase crop production can be carried out in a timely manner. Many of the areas that are not presently drained do not have adequate outlets. Placing crop rows to take advantage of what little slope is in the area is also a factor in drainage.

Soil tilth and fertility are important because they promote soil aeration and decrease the amounts of commercial fertilizer needed. This is done primarily by maintaining or increasing the organic matter content of the soil by plowing crop residue into the soil or leaving it on the surface. The absence of crop residue allows raindrops to hit the soil directly causing the breakdown of the natural soil aggregates. This lowers the water intake rate, increases runoff, and accelerates soil erosion. The crop residue, when decayed, contributes to better water infiltration, tilth, aeration, and natural fertility.

Other concerns in management that should be considered are erosion control and the conservation of moisture. Erosion is detrimental because it causes the most fertile upper part of the soil to be washed or blown away. This sediment clogs bayous, creeks, and rivers. Soil erosion by water is generally underestimated in the cropland areas because it is not easily recognized by obvious erosional rills. However, the normal cropping sequence and tillage practices on these nearly level soils generally control erosion to acceptable limits.

Although the more sloping soils in the county are generally not cropped, they are suited to cropland. They are, however, susceptible to severe erosion. Erosion can be controlled on these soils by intensive management practices; but, most landowners do not crop these areas because of the increased cost of installation and maintenance of these different management practices and controls and because of the small acreages involved.

Although there are times when the soil has too much water, conserving soil moisture is important because crops can go into moisture stress during the hot summer months. The plants are able to survive longer without going into moisture stress if enough moisture is stored in the soil early in the season. Conserving moisture enables the soil to produce a crop without moisture stress in most years. Soil moisture can be conserved by maintaining good tilth, by proper tillage and timely planting, and by leaving crop residue on the surface.

Several management practices can be used to maintain soil productivity. One that can be used on all soils is proper tillage. Tillage should be used only to prepare a good seedbed and to control weeds. Excessive tillage or working the soil when it is too wet reduces organic matter, destroys good tilth, causes soil compaction, and increases costs. It can also cause a plowpan, which is a compact layer immediately below the plow layer. A plowpan restricts air and water movement through the soil and makes root penetration difficult. The ultimate effects are increased runoff, restricted plant growth, and reduced yields.

A form of conservation tillage is recommended in most areas. This practice involves keeping the number of trips over the field with farm equipment to a minimum. Conservation tillage leaves more crop residue on the surface than conventional tillage. Leaving crop residue on the surface reduces soil compaction and increases water infiltration, available water capacity, and natural fertility.

The use of commercial fertilizer should be determined by the results of soil tests and by the needs of the crop. The amount and kinds of fertilizer needed vary according to the soil, the crop to be grown, the yield desired, previous land use, the season, and the available water content.

Most of the soils in Galveston County have a favorable soil reaction, or pH range, for the crops commonly grown and have a high capacity to buffer the pH so that the soils will not become too acid. It may, however, be necessary to apply lime to some soils when alkaline-

loving crops are grown. This need should be based on a recent soil test.

Another management practice is using a cropping system, or rotation of crops. In a good cropping system, crops are grown to offset the adverse effect of soil-depleting crops. A good cropping system provides good yields indefinitely. Some of the common rotations are: rice-soybeans, rice-grain sorghum, and soybeans-grain sorghum.

Many of the soils in the county are well suited to growing rice because of the flat topography and the very slowly permeable subsoil. The main rice producing soils are Lake Charles, Bernard, Bacliff, and Edna soils.

Rice is grown by flood irrigation. Irrigation water is supplied mainly by canal systems. Most of the management practices used for other crops are also important for rice production. However, since rice is grown under flood irrigation from the time the plant begins to tiller actively to several weeks before harvest, there are some differences. For example, good soil aeration is important while the rice is young and not flooded but is not a factor when the crop is flooded.

Adequate surface drainage is also very important except when rice is flooded. Good surface drainage permits timely seedbed preparation, planting, and harvesting. After the soil has been flooded for several months, it often becomes boggy and soft. With a good surface drainage system the field will dry more quickly because the floodwater can be removed more quickly. Also excess rainfall, which may occur during harvest, will drain off more readily.

Generally, some type of landforming or leveling is a common practice when growing rice. Landforming can be accomplished by removing the high spots and filling in the low spots in the field. The main objective of landforming is to make the land as smooth and even as possible so that a more uniform water depth is maintained within each cut or irrigation border. Landforming should leave a constant grade within each cut which will improve surface drainage. Water leveling consists of flooding the field and moving the soil hydraulically from the high areas to the low areas within the border by using blades attached to farm tractors while the field is flooded with water. Another type of landforming is cut and fill or precision land leveling when the field is dry. This type of landforming is accomplished by using scrapers to cut a designed grade on an entire field.

One or more flushes of irrigation water are commonly needed during the early part of the season. It is commonly used to maintain herbicide activity, to encourage uniform seed germination, and to maintain soil moisture in the surface layer to help control crusting. Surface crusting is mainly a problem on the heavy loamy and clayey soils because it is detrimental to the survival of emerging seedlings, and it allows weeds to grow through surface cracks where no pre-emergent herbicides can kill them.

Because rice is continuously flooded for most of the season and because the soil is often too wet for use of ground equipment, nearly all of the pesticides and fertilizer are applied by airplane. Seed is also often sown by this method.

Management of Pastureland and Hayland

Pasture is extensively used by livestock operators in the county. Dallisgrass and common bermudagrass are popular choices among livestock operators because they are adapted to a variety of soils. These grasses are productive in the better drained soils and in most of the poorly drained soils even without adequate drainage. These grasses are also desirable because they are suited to various levels of management. Alecia bermudagrass and Pensacola bahiagrass are used in some pastures. They are all warm-season plants.

One of the main concerns of livestock operators is the rapid decline in the nutrient level of the warm-season plants when the cool season arrives. In the past, many operators have overseeded the pastures with white clover, which can improve the quality of the forage for cattle during part of the cool season. However, maintaining clover in pastures has decreased in recent years since it is somewhat difficult to maintain over many years. Temporary pastures are often used to supplement permanent pastures and also are often used to produce hay. Ryegrass is often planted and provides good supplemental winter pasture.

The major concerns in management to use of the soils in Galveston County for pasture are proper fertilization, weed control, removal of excess surface water, and grazing control. Fertilizer should be applied according to plant needs, the level of production desired, and the results of soil tests.

Removing excess surface water is beneficial in most areas. This improves soil aeration, which promotes better plant growth. On most pastures and hayland, a surface drainage system has been installed or improved wherever possible. A good drainage system must have adequate outlets and be specially designed and properly installed. If adequate outlets are not available, a good drainage system can not be installed in some areas in Galveston County.

A variety of weeds invades pasturelands in Galveston County. Weed control is less of a concern if the pasture is well managed. Smutgrass is the most common weed and is difficult to control. Broadleaf weeds are controlled by good grazing management, proper use of chemicals, and mowing. The major woody plant invader on pastures is Chinese tallow, which can be controlled by chemicals or mechanical operations.

In Galveston County, native grasses, improved bermudagrasses and bluestems, bahiagrass, and annual

forage sorghum are mostly used for hay. Yields range from 1/2 of a ton to 6 tons or more per acre. Factors affecting yields are the kind of soil, the type of grass, the amount of fertilizer applied, and the management practices used.

The areas of native grasses used for hay are commonly referred to as "native hay meadows." These upland native grass areas are mostly on Verland, Bacliff, and Bernard soils. They support a mixture of grasses dominated by bluestems and paspalums. Normally, they are cut twice a year for hay. For the best quality hay, the first cutting should be prior to July 1, and the second cutting should be no later than August 30. Management of native hay meadows consists mainly of mowing at the proper height (no closer than 3 inches) and at the proper time to insure that plant vigor is maintained.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue and barnyard manure; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland *(22)*. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major, and generally expensive, landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not present in this survey area.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

There are no subclasses in class I because the soils of this class have few limitations.

Rangeland

Edward L. Seidensticker, district conservationist, Soil Conservation Service assisted with the preparation of this section.

Rangeland is the land on which the native vegetation is predominantly grasses, grasslike plants, forbs, or shrubs that are suitable for grazing or browsing. In areas that have similar climate and topography, the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between soils, vegetation, and water. Rangeland or native grassland receives no regular or frequent cultural treatment, such as fertilization or tillage.

Range sites are used in this report to discuss climax vegetative communities. A range site is the product of the climate, soil, topography, and biotic factors responsible for its development. The natural plant community that establishes and maintains itself, in the absence of abnormal disturbance, and physical site deterioration is the climax plant community for that site.

Range sites are subject to many influences that modify or even temporarily destroy vegetation. Examples of such influences are drought, grazing, fire, and short term tillage. Also, changes in soil characteristics, such as salinity and the high water table, can change the plant community. Conditions that cause these changes include drainage and hurricane storm tides. If these conditions are not too severe, the plant community will recover and return to the climax. However, severe site deterioration can permanently alter the potential of the site.

Table 7 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the climax plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants, but it does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an average year, growing conditions are about normal. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the climax plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the climax plant community on a particular range site. The more closely the existing community resembles the climax community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site remain or improve to about the same in kind and amount as the climax plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides habitat for wildlife, and protects soil and water resources.

Approximately 62,000 acres, or 24 percent, of the survey area is rangeland. The rangeland in Galveston County is classified as upland or prairie rangeland and as marsh or wetland rangeland.

Management Practices

Good production of livestock and forage on rangeland is obtained primarily by managing the time of grazing and limiting the amount of forage removed. The green parts of the plants manufacture food for growth and store part of it for use in regrowth and seed production. Management practices that are used in a grazing program permit this process to take place.

Planned Grazing Systems.—This is a management practice used in marsh and prairie rangelands. Its objective is to rotate livestock through two or more pastures in a planned sequence for a period of years to meet the deferred grazing needs of the plant community and the nutritional needs of the livestock. A planned grazing system may be relatively simple in design, using two pastures; or may be more complex and require intensive management, using one or two herds and numerous pastures. It must be tailored to each ranch

unit and meet the needs of the plants and animals and allow for the rancher's abilities and desires to succeed.

Proper Grazing Use.—This is a practice used in marsh and upland prairie rangelands. Its objective is to graze at an intensity that will maintain enough cover to protect the soil and maintain or improve the quality and quantity of desirable vegetation.

Deferred Grazing.—This is a practice used in marsh and prairie rangelands. It defers or restricts grazing until the desirable plants have completed most of their seasonal growth or have produced seed. It helps keep the desirable plants healthy and vigorous and permits plants that have been depleted to become strong again.

Fencing.—This is a practice used in marsh and prairie rangelands. It excludes livestock from areas that should be protected from grazing, confines livestock to an area, subdivides grazing land to permit use of a planned grazing system, and protects new seedlings or plantings from grazing.

Fence locations must be carefully planned, particularly in marsh rangeland. These fence locations must allow cattle access to high ground during periods of high tides or rainfall and they must fit into a good prescribed burning program. Because of the inherent salinity of the soil and water in the marsh, freshwater must be provided within each fenced area. The high cost for maintaining fences in the marsh areas is caused by the corrosive salt spray and should be an important consideration if this management practice is to be used.

Fresh Water Supply.—This is the practice used to provide good water for livestock. Watering places should be provided for livestock at various points in the grazing area to decrease the grazing pressure around a single watering place and make the grazing of the entire range more uniform. In some areas where water is trapped in earthen pits and the pits are used as the water supply point, cattle watering from these pits may become infested with liver flukes.

Water in the marshes is generally salty, and most of the freshwater from natural lakes and drains that overflow in the marshes is affected. Therefore, it is generally necessary to use the freshwater from wells or dug pits that trap rainfall. Pits dug in spoilbanks along canals and walkways can also be used to trap and hold rainwater or freshwater that drains from inland areas.

Shelters and Windbreaks.—This is a common practice used in marsh rangeland, but it is also used in prairie rangeland. This is any structure that provides protection for livestock during severe cold, wet winds in the winter. Shelters and windbreaks are needed if natural protection is not available for cattle.

Cattle Walkways.—This is a practice used only in the marsh rangeland. Cattle walkways are small continuous earthen embankments built in marsh areas that are not very accessible. They are used to provide more uniform grazing and bedding grounds for livestock, to facilitate ranching operations, and to make the marsh more accessible to livestock, ranchers, and hunters. In constructing walkways, borrow pits should be staggered to prevent drainage of the marsh and to permit cattle to enter the grazing areas on both sides of the embankment. The pits will also hold some freshwater for livestock and wildlife use.

Prescribed Burning.—This practice is used most widely in the marsh rangeland but is used to some extent in prairie rangeland. Livestock operators and wildlife managers use this management practice to periodically burn off dense cover of mature vegetation. If done properly and at the right time, prescribed burning will stimulate new succulent growth for both cattle and/or wildlife and increase the availability of forage and/or encourage climax plants in upland rangeland. However, if the practice is used when the soil surface is dry, forage can be severely damaged because fire can reach the plant crowns and roots. Livestock operators and wildlife managers generally burn marsh areas about every 2 to 5 years. This should be done when the ground surface is very wet or covered with water.

Following is a description of the two types of rangeland and a description of the range sites:

Marsh Rangeland

This is the most extensive and important type of rangeland in Galveston County. It borders the numerous bays, the Gulf of Mexico, and the lower part of bayous that flow into the bays. The two general types of marsh rangeland consists of the type of soils that are on Galveston Island and Bolivar Peninsula and the type of soils that are on the mainland part of the county.

The rangeland along the Gulf side of Galveston Island and Bolivar Peninsula consists of sandy soils that vary from nonsaline and dry to extremely saline and wet. The vegetation varies in these areas from plant communities that grow plants associated with upland areas to those communities that grow plants in wet saline areas. The other type of marsh rangeland consists of soils that are predominantly loamy or clayey, saline, and wet much of the year. The vegetation consists of salt- and water-tolerant plants. In most cases, marsh rangeland has not drastically changed from the original plant community. Any drastic deterioration that has occurred is generally the result of a change in salinity or high water table and not because of grazing pressure from livestock.

Most plants are responsive to salinity in the soil and water, soil texture, frequency and duration of tidal inundation, and the depth to the high water table. The plant community in the marsh adapts itself to a specific combination of these conditions. Altering any of these factors can drastically change the plant community. Depending on the objective, the rancher can alter or preserve the balance of the present plant community. However, he needs to have a thorough understanding of the effect any change will have on the plant community

and how the changes will affect the use of the marsh for livestock and wildlife habitat, and also how it will affect the marine ecosystem.

The usual grazing period in marsh rangeland is from about October to April. Cattle adapted to the marsh rangeland do well during this time of the year except during severe storms or cold, wet weather. The abundance of insects, particularly mosquitos, is one of the important factors that makes moving the cattle to other areas necessary during the rest of the year.

Marsh rangeland is divided into eight range sites. They are the Coastal Sand, Coastal Swale, Deep Marsh, Low Coastal Sand, Salt Flat, Salt Marsh, Salty Prairie, and Tidal Flat range sites.

Coastal Sand Range Site.—Galveston soil in map unit Gs and Sabine soil in map unit Sa are in this site.

This range site is on nearly level to undulating convex coastal ridges that parallel the Gulf of Mexico. Elevation is less than 12 feet above mean tide level.

The climax plant community in this site is dominated by little bluestem. Switchgrass, Florida paspalum, and brownseed paspalum occur in smaller amounts. Several sedges and forbs are also native to this site. Woody vines and shrubs, such as dewberry and eastern baccharis, occur to some extent.

As retrogression takes place, slender bluestem and brownseed paspalum are strong increasers. In a deteriorated condition, invader plants, such as bushy bluestem, carpetgrass, gulf muhly, ragweed, indigo, smutgrass, baccharis, and woody vines and annuals, dominate the site.

Coastal Swale Range Site.—Mustang soil in map unit Mp and Nass soil in map units Gc, Mt, Ns, and Nx are in this site.

This range site is in shallow depressions on nearly level coastal flats and in low coastal swales. Elevation is less than 5 feet above sea level. The primary characteristics of the soils are the sand texture, moderate soil salinity, and persistent high water table. The degree of salinity varies greatly during the year because of differences in rainfall, evaporation, temperature, and high water table. Generally, the soils are more salty during the summer and are less salty during the winter or following periods of heavy rain.

The climax plant community is variable because the salinity and high water table varies. In areas with concave topography, the dominant plant is marshhay cordgrass, which grows in all parts, except the center, of the wetter areas. In areas with plane to slightly convex topography, plants, such as marshhay cordgrass, seashore saltgrass, seashore paspalum, gulfdune paspalum, shoregrass, gulf cordgrass, and red lovegrass, may be present. The vegetation in this community is typically somewhat sparse in certain parts.

As retrogression occurs in the depressional areas, marshhay cordgrass decreases as seashore saltgrass, sedges, and rushes increase. Needlegrass rush can become dominant if conditions are favorable for its growth. A retrogression introduced by a drought causes more salt-tolerant plants to replace the local community. In transition areas along the edge of depressions or in depressional areas that have been artificially drained, seashore saltgrass, seashore paspalum, shoregrass, or glasswort will replace bulrushes. Continued retrogression increases the amount of barren areas and also increases sedges, rushes, shoregrass, and glasswort.

As retrogression occurs in plane to slightly convex areas, marshhay cordgrass decreases and is replaced by red lovegrass and bushy sea-oxeye. Continued retrogression eliminates marshhay cordgrass and decreases seashore saltgrass, seashore paspalum, and some gulf cordgrass, but it increases red lovegrass, bushy sea-oxeye, and glasswort. Barren areas also increase.

Perennial plants are necessary to effectively keep vegetative cover on this range site. Reclamation and revegetation can be extremely difficult because of excessive salinity and a continuous high water table. The depressions are easier to vegetate because the salinity is more consistent. The water table, however, is high for many plants. To obtain more consistent results, vegetative propagation is generally desirable.

Deep Marsh Range Site.—Caplen soil in map units Ca and Ct is in this site.

This range site commonly occurs in the marsh in areas adjacent to bays and bayous that are protected from direct tidal action. Although this site is generally affected by daily tides, the salinity of the tidal waters is lower because it occurs in saltwater and freshwater interface areas. Elevations range from mean sea level to 1 foot above sea level. The plant community balance is sensitive to change and can be easily destroyed. This site has a surface layer that has a large amount of organic matter. To maintain this range site, abundant amounts of organic matter must be added on a regular basis. If this organic material is lost, the area will subside and be covered by water. This will change the plant community or may totally destroy it by becoming areas of water.

The organic material may be lost in a number of ways. If this site is burned when the organic material is dry, the organic material will burn away and destroy all of the plant cover. Artificial drainage can also destroy the organic material by allowing it to dry out, thus allowing it to oxidize. Also, drainage can allow saltwater to intrude into the site. The result is overall increased salinity, more direct tidal action, and increased velocity of the tidal water. Organic material is then turned into a "soup," which is more easily swept away by tidal action. This process not only causes holes in the vegetative cover, which may develop into shallow water bodies, but also causes the elevation to drop slightly. The result can be an increased percent of open water that may continue to increase, or it may change into a deteriorated range

condition. This is not generally a rapid process but one which becomes evident over the course of several years.

This site is only suitable for wildlife because the soil surface is too soft and normally will not support the weight of livestock.

The climax plant community in this range site is dominated by marshhay cordgrass and big cordgrass. Depending on water depth and salinity, some small amounts of seashore saltgrass, sagittaria, bulrushes, and iris are in the site. Typically, small areas of open water also are in this range site.

Retrogression in this site can be either manmade or climatically induced by one or more of the factors mentioned earlier. The initial retrogression, which has already occurred, is the decrease in big cordgrass, which is replaced primarily by marshhay cordgrass. Today, big cordgrass is seldom observed in the county. Common reed can be a strong increaser in some places, while seashore saltgrass can increase in other areas. The next stage of retrogression is the continued decrease in the percent of vegetative cover in the site, which is replaced with areas of water. In some cases, smooth cordgrass becomes dominant.

Low Coastal Sand Range Site.—Galveston soil in map units GaB, Gc, and Nx; Mustang soil in map units Mn and Mt, and Mustang soil, slightly saline, in map unit Ms are in this site.

This range site occurs on the nearly level to gently sloping coastal sands that generally parallel the Gulf of Mexico. Elevation is generally less than 10 feet above mean tide level.

The climax plant community is dominated by gulfdune paspalum and marshhay cordgrass. However, bushy bluestem, red lovegrass, and knotroot bristlegrass occur in smaller amounts.

Under retrogression, gulfdune paspalum and marshhay cordgrass decrease rapidly and are replaced by plants such as red lovegrass, bushy bluestem, knotroot bristlegrass, and common bermudagrass. Under continued retrogression, common bermudagrass and red lovegrass dominate the site with various weeds, vines, and forbs. Woody plants, such as baccharis and southern waxmyrtle, may also be abundant in this range site.

Revegetation after disturbance is generally not difficult if the user realizes that the soil surface will become dry. Often vegetative propagation is desirable. In this range site, many different types of vegetation can be grown. Plants that will tolerate salt spray and are adapted to sandy soils that are not wet will probably grow in this site.

Salt Flat Range Site.—Mustang soil, strongly saline, in map unit Ms and Veston soil, very strongly saline, in map unit Vx are in this site.

This range site occurs in nearly level coastal marshes. The elevation ranges from slightly above mean sea level to 3 feet above sea level. The high water table varies from at or near the surface to 15 inches below the surface. The salinity varies with the time of the year but is generally strongly saline for much of the year.

The climax plant community is variable depending on elevation, high water table, and drainage. It is composed mainly of maritime saltwort, shoregrass, glasswort, and bushy sea-oxeye that are interspersed with barren areas. Seashore saltgrass, sea lavender, seepweed, Carolina wolfberry, and eastern baccharis also occur in the site.

If retrogression is livestock induced, seashore saltgrass, bushy sea-oxeye and Carolina wolfberry decrease. Since no plants are really increasers in this range site, it generally becomes more barren. If retrogression is climatically induced, maritime saltwort and glasswort increase slowly while other plants decrease rapidly which results in a higher percentage of barren areas.

Salt Marsh Range Site.—Harris soil in map unit Ha, Placedo soil in map unit Pd, Veston soil in map unit Vs, and Veston soil, strongly saline, in map unit Vx are in this site.

This range site occurs in nearly level coastal marshes and on flood plains. Elevation ranges from 1 foot to 4 feet above sea level. Small shallow depressions, which are filled with water at least part of the year, are common in many areas. These open-water areas are of great importance to waterfowl and other wildlife.

Marshhay cordgrass and seashore saltgrass comprise most of the climax plant community. Also, in the plant community are small amounts of seashore paspalum, seashore dropseed, olney bulrush, saltmarsh bulrush, saltmarsh aster, and needlegrass rush.

Under retrogression, marshhay cordgrass decreases while seashore saltgrass or seashore paspalum increase and with continued retrogression, may eventually dominate the site. Saltmarsh aster, bushy sea-oxeye, and bulrushes also increase somewhat. The less saline parts in this site are indicated by the presence of common reed, seashore paspalum, and longtom.

Salty Prairie Range Site.—Francitas soil in map unit Fr, Ijam soil in map units ImA and ImB, Narta soil in map unit Na, Sievers soil in map unit SeB, Veston soil in map unit Vn, and Veston soil, slightly saline, in map unit Vx are in this site.

This range site is on broad, nearly level coastal flats and in marshes. Elevation ranges from 2 to 8 feet above sea level (fig. 12).

The climax vegetation in this site is dominated by gulf cordgrass. Also in the plant community are small amounts of little bluestem, switchgrass, indiangrass, marshhay cordgrass, knotroot bristlegrass, and longspike tridens.

As retrogression takes place, little bluestem, switchgrass, and indiangrass decrease as gulf cordgrass and knotroot bristlegrass increase. Gulf cordgrass will persist well in this site even under adverse grazing. Under continued retrogression, smutgrass, red lovegrass,

Figure 12.—These grazing cattle are on Narta fine sandy loam in the Salty Prairie range site.

croton, and bitter sneezeweed invade the site. In the more saline areas, gulf cordgrass occurs as essentially pure stands. Where the salinity decreases in low-lying areas, common reed is more abundant.

Tidal Flat Range Site.—Follet soil in map unit Fo, Karankawa soil in map unit Ka, Tatlum soil in map unit Ta, and Tracosa soil in map units Ct, Tm, and Tx are in this site.

This range site is in broad, nearly level coastal marshes and tidal areas that are adjacent to bays and saline bayous. The soils are subject to daily tidal inundation. This site is at an elevation slightly below sea level to about one foot above sea level. The high water table is at or above the surface throughout the year. About 2 to 12 inches of water stands on the surface during most high tides. During low tides, all but 1 or 2 inches normally drain off. Salinity of the water varies from 1.2 to 5 percent salt but may be lower during periods of high rainfall. This site is very important for the marine ecosystem since it is the beginning of the food chain.

The plant community is dominated by smooth cordgrass in climax condition, which is specifically adapted to this site. Seashore saltgrass, glasswort, maritime saltwort, and saltmarsh bulrush may also be present in small amounts. Widgeongrass may occupy some of the fresher, shallow open water areas.

Retrogression is generally climatically induced, which causes a slight increase in glasswort, maritime saltwort, and saltmarsh bulrush. These plants are not true increasers in this site. Retrogression induced by heavy grazing generally causes smooth cordgrass to thin out and is not replaced appreciably by any other plants. Continued retrogression continues to decrease the amount of smooth cordgrass and is replaced by water.

Prairie Rangeland

The original prairie vegetative rangeland in Galveston County has been drastically altered in the past 75 years to 100 years. Much of the rangeland that contains many of the original native prairie vegetation plants is presently not used for livestock grazing. Examples of this are native prairie hay meadows that are cut annually for prairie hay.

Heavy grazing pressure has resulted in a great change in most of the remaining grassland to where much of the higher quality vegetation has been grazed out. In most cases, good grazing management will allow these high quality plants to reestablish themselves again over a period of years.

These prairie soils generally are low in available phosphorus, and the forage generally does not have enough protein for a balanced diet during the fall and winter. Mineral supplements are needed at this time.

Prairie rangeland is divided into four range sites. They are the Blackland, Claypan Prairie, Loamy Prairie, and Lowland range sites.

Blackland Range Site.—Arents in map unit AaB, Bacliff soil in map unit Ba, Bernard soil in map units Be and Bn, Lake Charles soil in map units LaA, LaB, and Lx, Vamont soil in map unit Va, and Verland soil in map unit Ve are in this site.

This range site is on broad uplands. Drains are shallow and widely spaced, which results in slow or very slow surface drainage. Slopes are mainly less than 1 percent but may be as much as 5 percent along drainageways. Some areas are hummocky with microknolls 6 to 15 inches higher than microdepressions.

The climax vegetation is considered to be a true prairie. It is dominated by little bluestem. However, indiangrass, switchgrass, and eastern gamagrass occur in smaller amounts. Also occurring, but less frequently, are smaller amounts of Florida paspalum, big bluestem, brownseed paspalum, low panicums, and sedges. Several native forbs are prominent in this site. Woody vines also occur to some extent but contribute little to production.

As retrogression occurs, brownseed paspalum, meadow dropseed, and longspike tridends are likely increasers in this range site. In a deteriorated condition, common invaders growing on this site include bushy and broomsedge bluestem, carpetgrass, smutgrass, vaseygrass, annual grasses and weeds, and many species of brush, such as baccharis, sumpweed, Chinese tallow, and sesbania.

Claypan Prairie Range Site.—Edna soil in map units Bn, Ed, and Es is in this site.

This range site occurs on broad uplands. The thin topsoil over a dense, heavy clayey subsoil makes this site susceptible to moisture stress and drought during dry periods of the year.

The climax vegetation in this site is considered to be a true prairie. It is dominated by little bluestem. However, indiangrass, switchgrass, big bluestem, brownseed paspalum, and various forbs occur in smaller amounts.

As retrogression occurs, brownseed paspalum is a strong increaser and Florida paspalum, low panicums, longspike tridens, and knotroot bristlegrass also tend to increase. With continued retrogression, smutgrass, bushy bluestem, carpetgrass, broomweed, and baccharis tend to dominate the site.

Loamy Prairie Range Site.—Algoa soil in map unit Mb, Aris soil in map units Ar, Es, and Ls, Kemah soil in map units KeA and KeB, Mocarey soil in map units Ma, Mb, Mc, and Md, Morey soil in map units Me and Mf, and Stowell soil in map unit StA are in this site.

This range site occurs on broad, level or nearly level uplands. Slopes are mainly less than 1 percent but may be as much as 3 percent along the narrow drainageways. The climax vegetation in this site is considered a true prairie.

Little bluestem dominates the climax plant community. Indiangrass and switchgrass are subdominants. Also occurring, but less frequently, are eastern gamagrass, big bluestem, Florida paspalum, brownseed paspalum, knotroot bristlegrass, longspike tridens, longtom, low panicums, and sedges. Several native forbs and legumes are common in this site.

As retrogression occurs, low panicums, longspike tridens, knotroot bristlegrass, sedges, and various other plants increase. Brownseed paspalum is a strong increaser and may dominate the site in an intermediate stage. In a deteriorated condition, smutgrass and carpetgrass tend to dominate. Broomsedge and bushy bluestem, vaseygrass, goldenrod, wild indigo, and dogfennel are subdominate. Woody invaders on this site are waxmyrtle, baccharis and Chinese tallow.

Lowland Range Site.—Cieno soil in map unit Mc, and the Leton soil in map units Le, Ls, Lx, Md, Mf, and StA are in this site.

This range site occurs on low-lying flats along drainageways and in depressed swales or small potholes. Slopes are less than 1 percent. This plant community may have been drastically altered in the past because of drainage.

Switchgrass, maidencane, and eastern gamagrass tend to dominate the site in climax condition. Also occurring, but in smaller amounts, are indiangrass, Florida paspalum, longtom, squarestem spikesedge, brownseed paspalum, knotroot bristlegrass, and low panicums. Depending on the depth of water in the site, many varied sedges and rushes also occur. Areas of water also occupy part of the range site.

During retrogression, longtom, brownseed paspalum, and longspike tridens are strong increasers. Knotroot bristlegrass, sedges, and low panicum also increase. In deteriorating condition, plants, such as needlegrass rush, sedges, rushes, vaseygrass, carpetgrass, smutgrass, baccharis, and sesbania tend to dominate the site.

Landscaping

Sandra Thorne-Brown, forester, Soil Conservation Service, assisted in the preparation of this section.

Expanding urbanization in Galveston County has resulted in increased construction of residences, beach houses, and commercial establishments. This surge in construction has increased the need for landscaping to complement structural designs and improve the living environment. The variety of landscape materials utilized in most of the county has been limited to a relatively few common or standard plants. Although many have been proven to be good, some plants are less adapted to certain areas, while others are still used even though they have not done well in the past. A good opportunity on the part of nurseries, landscapers, and individual homeowners to expand the variety of landscape materials is available and can be utilized.

A look at landscape plants used in other coastal areas suggests many plants that are adapted but not often planted in Galveston County. Plants native to the Texas coast can also be utilized more frequently, and a surprising number of plants native to deep east Texas are also suited to soils in Galveston County. Being aware that these additional plants are adapted can increase the alternatives to select landscape plants.

The soils of Galveston County range from sandy to clayey, nonsaline to extremely saline, and somewhat excessively drained to poorly drained. Soils that are ideally suited to landscaping have a deep root zone, loamy texture, balanced supply of plant nutrients, favorable pH, plenty of organic matter, a medium to high available water capacity, good drainage, and granular structure that allows free movement of water and air to the roots. Many of the soils have one or more features that make them less than ideal for landscape plantings. A knowledge of the soil involved is of primary importance before landscaping attempts are made. Plant materials should be suited to the soil to avoid costly plant replacements or soil amendments.

Table 8 shows the recommended plants by map units that are suited to landscape plantings. An attempt has been made to separate the plants into categories according to size. A large tree here is considered to be over 30 feet tall, a small tree from 10 to 30 feet, and a shrub to have multiple stems and range in height from 1 foot to 10 feet. However, there is no clearcut distinction between each category. A shrub growing under good conditions and proper pruning may be considered a small tree, and a large tree growing in a poorly suited soil or continually bombarded by winds and salt spray may be considered little more than a shrub. Many of the plants included in table 8 are not easily available from local nurseries and will not be until the demand for adapted plants increases.

This is by no means a list of all adapted plants. Some plants that are commonly planted have been purposely omitted, especially if they grow in most of the soil types in the county. Additional information is available through the local office of the Soil Conservation Service or the Texas Agricultural Extension Service.

Aris, Edna, and Kemah soils have a loamy surface and a dense, clayey subsoil. They are somewhat poorly drained to poorly drained. These soils are very slowly permeable. Reaction is medium acid to neutral. The topsoil is a fairly shallow to the dense, clayey subsoil. The natural fertility is somewhat low. Precipitation that penetrates the topsoil perches on top of the subsoil because the subsoil takes water very slowly. This causes the topsoil to become saturated following heavy rains. Plants tend to be shallow rooted because the roots tend to remain in the loamy topsoil rather than growing into the dense, clayey subsoil. If the topsoil is less than about 12 inches thick, the plants are especially prone to drought stress during the summer months. It is necessary to keep new plantings well watered for the first 2 years in these soils, or until they are well established. Thereafter, regular watering should be done before the topsoil becomes dry. Adding organic matter will increase the available water capacity of these soils.

Algoa, Cieno, and Mocarey soils are loamy soils that are somewhat poorly drained. They are slowly permeable to moderately slowly permeable. These soils are moderately alkaline and have a calcareous subsoil. The natural fertility is generally good. Plants that are not adapted to a calcareous soil will develop yellow leaves and become chlorotic, which retards the plants growth when the root system reaches the calcareous layer. These plants are more susceptible to diseases. This is the reason that some plants, such as most pines, do well for several years but grow poorly later. Most of these soil in their native condition contain mounds. The common practice of leveling before landscaping brings the calcareous layers closer to the surface and can also make the soil salty where the mounds were. Therefore, caution should be used to insure that any leveling will not adversely affect the plants to be planted.

Bacliff, Bernard, Lake Charles, Morey, Vamont, and Verland soils are clayey and loamy soils, and they are somewhat poorly drained to poorly drained. These soils are slowly permeable to very slowly permeable. Reaction is medium acid to moderately alkaline. The natural fertility of the Bernard, Lake Charles, and Morey soils is generally fairly good while the natural fertility of the Bacliff, Vamont, and Verland soils is somewhat low. Providing additional drainage is beneficial to keep water from ponding following rains. The tight, clayey nature of most of these soils poses problems when enthusiastic landscapers prepare and backfill the planting hole. If the planting hole is filled with organic material, such as peat moss or rich loamy topsoil, it will accept water readily while the surrounding clay soil accepts water very slowly. This causes the planting hole where all the plant roots are to become saturated with water, and the new plant

often dies from drowning because the roots cannot receive the necessary oxygen for growth. Therefore, in these soils, the planting hole should be backfilled with the original soil or with only a slightly enriched heavy soil. Initial soil preparation is difficult on the clayey soils because the soil tends to break up in large clods. They are very sticky when wet and very hard when dry. Adding gypsum, according to instructions and incorporating organic matter help to improve these soils.

Leton soil is a strongly acid to neutral, loamy soil that is in low wet areas to large wet depressions. It is poorly drained. Runoff is very slow and water often ponds for some time during the year. Landscaping these areas in their native state is difficult because the high water table is at or above the soil surface during part of the year. Although some plants are adapted to these conditions, each plant has its own limits of adaptability to the depth of water it grows in and the length of time that the high water table can be at a certain level. Therefore, general recommendations are not feasible in the soil's native state. Before the suggested plants in Table 8 are used, this soil must be drained by ditching or by filling with a suitable topsoil to raise it above the wintertime high water table level or to raise it enough to prevent water from standing on the surface for long periods. Generally, plants selected should be tolerant of wet conditions. Additions of organic matter improve the natural fertility.

The Beaches soil map unit takes in the land adjacent to the Gulf of Mexico between the low tide and the immediate coastal dune that may be present. It consists of sandy marine deposits. The only part of the map unit that can be vegetated is the dune. These areas are sandy, which makes them droughty. They are also exposed to salt spray. Caution should be used when working in dune areas because they are very susceptible to erosion if disturbed or left unprotected. These dunes are, of course, susceptible to severe erosion during storm tides. This must be realized before any landscaping is done. Landscaping the dunes is best accomplished by planting a grass that is well adapted to the site conditions. Marshhay cordgrass and bitter panicum are good choices, and sea-oats works well on the drier, stable dune sites. The leeward side of the dunes can also be planted to forbs and woody vegetation if the site is fairly stable with vegetation. This is often a lengthy and frustrating task, which can be made somewhat easier by replacing the sand in the planting hole with topsoil. Set the plant about 2 inches deeper than it grew in the nursery and leave a bowl-shaped depression to facilitate watering. Ground cover and vines that do fairly well on these sites include Virginia creeper, muscadine grape, wild bamboo, largeleaf pennywort, and lippia. Woody shrubs to plant include waxmyrtle, tamarisk, marsh elder, eastern baccharis, and devilwood osmanthus.

Mustang, saline, and the Nass soils are sandy. They are poorly drained or very poorly drained. The surface runoff is very slow to ponded. The permanent high water table is between depths of 10 inches below the surface and about 15 inches above. These soils are saline and alkaline.

Water easily penetrates these soils if they are not already saturated. In its native state, the salinity is too high on the saline Mustang soils and the water table is too high in the Nass soils to be adapted to general landscape plantings. Before the plants in table 8 are planted, the soil must have elevated planting beds or be filled with a suitable material to a height at least 15 inches above the permanent high water table and be protected from regular tidal inundation. After the fill material is added, landscaping should be delayed until the salinity becomes stable. The fill material should be porous enough to allow salts to be easily leached. Plants will benefit from additions of organic matter in the planting hole and thorough waterings to leach out excess salts. Soil wetness and salinity restrict the kinds of plants that will do well on these sites. In most cases, the fill material is sandy and additions of organic matter help to improve the fertility level and the available water capacity. Fertilizer should be applied in small amounts at frequent intervals since these soils leach nutrients easily.

Galveston, Mustang, Sabine, and Stowell soils are sandy. These soils are poorly drained to somewhat excessively drained. They are moderately rapidly permeable to rapidly permeable. These soils are neutral to alkaline but are not saline. For most landscape purposes, these soils are similar in that they are sandy and nonsaline in most of the root zone, and they are all exposed to salt spray from the Gulf. Perhaps the factors most limiting landscaping of these soils are infertility and low available water capacity, which is associated with the sandy texture. Plants must also be able to tolerate salt spray from Gulf winds. Planting sites would benefit from addition of organic matter or rich topsoil to improve the nutrient and available water capacity. Fertilizer should be applied in small amounts at frequent intervals since the soils leach nutrients easily. It is necessary to keep new plantings well watered for the first few years until they are well established. If large trees are transplanted, they should be staked until the root system becomes established so that they will not blow down.

Francitas, Narta, and Veston soils are clayey and loamy and have a dense, clayey and loamy subsoil. These soils are somewhat poorly drained to poorly drained. They are very slowly permeable. These soils are saline and alkaline. The wetness and salinity of these soils restrict the number of plants suitable for planting. Landscape plantings on these soils would benefit from drainage and elevated planting beds. Plants may show indications characteristic of moisture stress even when the soil is moist. Moisture stress is an indication that the salinity is becoming too high for the plants. Periodic, thorough watering of the plants helps to keep the salt in the root zone at acceptable levels. This is especially true

for the Narta soil because the roots tend to remain in the shallow, loamy topsoil rather than grow into the dense, clay subsoil. This results in a shallow root zone that can quickly dry out during the summer.

Recreation

In table 9, the soils of the survey area are rated according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface absorbs rainfall readily but remains firm and is not dusty when dry. Strong slopes can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is firm after rains and is not dusty when dry. If grading is needed, the depth of the soil over a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Frank Sprague, biologist, Soil Conservation Service, assisted in preparing this section.

Galveston County provides habitat for a large concentration of wintering waterfowl. Sport fishing for saltwater species inhabiting the bays and estuaries of the county is a major recreational resource for area residents and visitors.

Game species in the county include ducks, geese, dove, deer, bobwhite, quail, squirrel, coot, snipe, rail and sandhill cranes. Ducks and geese are the most hunted game species, and many landowners receive income from leasing the hunting rights to their property. Furbearers include raccoon, fox, skunk, nutria, mink, bobcat, coyote, and beaver. Numerous raptors, shore birds and song birds inhabit the county because of the diversity of climate, water, and soil resources.

Important saltwater sport fish found in the bay include spotted weakfish, redfish, flounder, black drum and sheephead. Freshwater species include largemouth bass, channel catfish, crappie, sunfish, and numerous forage fish. Alligators, water moccasins, frogs, turtles, and other reptiles and amphibians are associated with wetlands throughout the county.

Aquaculture and mariculture activities have potential as an industry in the county where suitable soil and water resources are available.

Information and assistance concerning wildlife management can be obtained from the Soil Conservation Service or Texas Parks and Wildlife Department. Assistance in aquaculture and mariculture activities is available from the Soil Conservation Service and the Agricultural Extension Service.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and

distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, grain sorghum, soybeans, sunflowers, and millet.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are tall fescue, gulf ryegrass, oats, common bermudagrass, lespedeza, and winter peas.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, paspalum, panicum, sunflowers, crotons, black medic, clover, snow-on-the-prairie, ragweed, and broomweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, pecan, elm, hackberry, black walnut, red mulberry, persimmon, hawthorn, and osage-orange.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are yaupon, coralberry, arrowwood viburnum, possumhaw, elderberry, American beautyberry, grapes, greenbrier, Carolina snailseed, honeysuckle, dewberry, and blackberry.

Wetland plants are annual and perennial, wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, and slope. Examples of wetland plants are smartweed, sprangletop, burhead, arrowhead, cordgrass, wild millet, coastal waterhyssop, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Most are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are wetness, slope, and permeability. Examples of shallow water areas are marshes, bays, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, dove, and cottontail.

Habitat for woodland wildlife consists of areas of deciduous plants and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include woodpeckers, squirrels, opossum, owls, and crows.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are raccoon, nutria, ducks, geese, herons, alligators, and shore birds.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyote, meadowlark, opossum, and dove.

Various management tools are used in wildlife management and are described below.

Prescribed Marsh Burning.—The use of fire under prescribed conditions in the marshes can have both good and bad effects depending on how and when it is done. When the results are good, it can be a valuable waterfowl management tool for maintaining or improving desirable vegetation. Prescribed-type burns are employed to accomplish the objectives with minimal adverse effects.

Water Level Management.—Water management is another important habitat management tool employed in marshlands if it is done properly. However, a thorough understanding of salinity, the depth and fluctuations in the high water table, and the plant communities are required to consistently get the desired results; otherwise, the results can be bad. Maintaining proper water levels is very important as the depth and changes in water level affect waterfowl diversity, use, and abundance. Low water tidal weirs, earthen plugs, and flashboard risers are the types of structures most widely used to hold water for waterfowl. Structures, such as the weirs, serve several useful purposes. They reduce water fluctuations and the rate of tidal exchange, prevent drastic salinity changes, minimize water turbidity, reduce water temperature fluctuations, and increase the area and duration of flooding; all of which are essential to the production of desirable vegetation that attracts waterfowl.

Proper Grazing Use.—Carefully controlled cool-season marsh grazing is another marsh management practice used to benefit waterfowl. Proper grazing is an effective means of opening up dense stands of grasses, sedges, and rushes; increasing the food availability for waterfowl, and acting as a stimulating agent in encouraging plant retrogression for enhanced wildlife use. However, a thorough understanding of plant succession is needed before attempting this so the desired results can be obtained. For example, the retrogressive plant succession to a vegetative composition of 30 percent or less marshhay cordgrass and 70 percent mixed rushes and related plants is an optimum goal for the Salty Prairie range site.

Other Management Practices.—Land used for cropland, pastureland, or woodland also functions as quality habitat for a wide spectrum of wildlife when practices, such as planned crop rotation, crop residue management, fallow, spring disking of idle field borders, and leaving small areas of unharvested grain next to cover, are effectively applied.

Many harmful practices to wildlife that are most often encountered include indiscriminate burning, use of chemicals as weed killers and insecticides, heavy grazing, complete clean mowing early in the growing season, clean fall plowing, draining of wetland depressions, and removal of den and mast producing trees in wooded areas.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to: evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and are considered *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by a very firm dense layer, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to a high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. Depth to a high water table, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to a high water table, flooding, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, depth to a high water table, the available water capacity in the upper 40 inches, and the content of salts and sodium affect plant growth. Flooding, wetness, slope, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, and flooding affect absorption of the effluent.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent and surfacing of effluent, can affect public health. Ground water can be polluted if highly permeable sand is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many

local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, depth to a high water table, flooding, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope can cause construction problems.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill-trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, slope, and flooding affect both types of landfill. Texture, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by a high water table and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand. They have at least 5 feet of suitable material and low shrink-swell potential. Depth to the high water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles, have a plasticity index of less than 10, and have moderate shrink-swell potential. Depth to the high water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10 and a high shrink-swell potential. They are wet, and the depth to the high water table is less than 1 foot. They

may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by slope, a high water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a high water table, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, or soils that have an appreciable amount of soluble salts. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of soluble salts, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives the restrictive features that affect each soil for drainage and irrigation.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of organic matter or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and the salinity of the soil.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope;

susceptibility to flooding; and subsidence of organic layers. Excavating and grading and the stability of ditchbanks are affected by the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(3)* and the system adopted by the American Association of State Highway and Transportation Officials *(2)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20, or higher, for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area, or from nearby areas, and on field examination.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence the soil's shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time. The capacity for water storage in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the

more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as *none, rare, occasional,* or *frequent. None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (there is a near 0 to 5 percent chance of flooding in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (there is a 5 to 50 percent chance of flooding in any year). *Frequent* means that flooding occurs often under normal weather conditions (there is more than a 50 percent chance of flooding in any year). *Common* is used when classification as occasional or frequent does not affect interpretations. Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that floods are most likely to occur is expressed in months. November-May, for example, means that flooding can occur during the period November through May. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely thin strata of sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils and does not apply to poorly drained soils that have been artificially drained. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table, that is, *perched* or *apparent*; and the months of the year that the water table commonly is highest. This table should not be used to infer the depth of the water table during the season that it is low. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated

zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

The two numbers in the "High water table-Depth" column indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Table 17 shows subsidence that results from desiccation and shrinkage and oxidation of organic material following drainage. Table 17 shows the expected initial subsidence and total subsidence, which is initial subsidence plus the slow sinking that occurs over several years as a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severely corrosive environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(23)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquents (*Hapl*, meaning minimal horizonation, plus *aquent*, the suborder of the Entisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, mixed, nonacid, hyperthermic Typic Haplaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series. An example is the Karankawa series, which is a member of the coarse-loamy, mixed, nonacid, hyperthermic family of Typic Haplaquents.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual *(20)*. Many of the technical terms used in the descriptions are defined in Soil Taxonomy *(23)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Algoa Series

The Algoa series consists of nearly level, somewhat poorly drained, nonsaline, loamy soils in upland areas. The overall surface is slightly convex, and mounds are common. The slopes range from 0 to 1 percent. Some short slopes, which are associated with mounds, are about 3 percent.

Algoa and Mocarey soils occur in a complex pattern. Algoa soils are mainly on the mounds or in higher

positions on the landscape. Mocarey soils are on the intermounds or in slightly lower positions on the landscape.

Other associated soils are Cieno, Leton, and Morey soils. These soils are in lower positions on the landscape than Algoa soils and are leached of lime to a greater depth.

Typical pedon of Algoa silt loam; in an area of Mocarey-Algoa complex; from Texas Farm Road 646 north of Dickinson, 0.3 mile north on Farm Road 1266, 200 feet east on shell road, and 50 feet north, in a pasture:

A—0 to 12 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; few wormcasts; mildly alkaline; clear smooth boundary.

Bkg1—12 to 18 inches; grayish brown (10YR 5/2) loam, light brownish gray (10YR 6/2) dry; weak coarse subangular blocky structure; hard, friable, nonsticky and nonplastic; few fine roots; 15 percent soft calcium carbonate masses; common fine pitted concretions of calcium carbonate; 20 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear smooth boundary.

Bkg2—18 to 43 inches; light brownish gray (10YR 6/2) loam, light gray (10YR 7/2) dry; weak coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; 30 percent soft calcium carbonate masses; common fine pitted concretions of calcium carbonate; 33 percent calcium carbonate equivalent; few medium black concretions; calcareous; moderately alkaline; gradual smooth boundary.

Bkg3—43 to 58 inches; light gray (10YR 7/2) loam, white (10YR 8/2) dry; common fine distinct yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; hard, friable, sticky and slightly plastic; few fine roots; 35 percent soft masses of calcium carbonate; common fine pitted concretions of calcium carbonate; 45 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

2Cg—58 to 65 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; many fine prominent yellowish brown (10YR 5/6) mottles; massive; very hard, very firm, sticky and plastic; few medium pitted concretions of calcium carbonate; few medium black concretions; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to a calcic horizon ranges from 10 to 16 inches. Calcium carbonate equivalent of the 10- to 40-inch control section ranges from 15 to 40 percent, but in some parts, it ranges from 15 to 60 percent. Soft masses of calcium carbonate range from common to many. Up to 50 percent of these carbonates can be clay size. Concretions of calcium carbonate up to 3 inches across range from few to many. Most of these concretions have pitted surfaces. Typically, the concentration of calcium carbonate concretions increases with depth. The content of silicate clay in the control section ranges from 18 to 30 percent. Some pedons have a few dark concretions 2 to 4 millimeters in diameter.

The A horizon is black, very dark gray, very dark grayish brown, or very dark brown. It is 7 to 15 inches thick. Reaction is slightly acid to moderately alkaline.

The Bkg1 horizon is very dark gray, very dark grayish brown, dark gray, dark grayish brown, gray, grayish brown, light gray, and light brownish gray. Mottles in shades of brown or yellow range from none to common. Texture is silt loam, loam, clay loam, or silty clay loam. Reaction is typically moderately alkaline. This horizon is calcareous.

Some pedons have a thin Bw horizon that is mildly alkaline and noncalcareous.

The Bkg2 and Bkg3 horizons are gray, light gray, white, grayish brown, light brownish gray, brown, pale brown, or very pale brown. Mottles in shades of yellow and brown range from none to common. Texture is loam, clay loam, or silty clay loam. Reaction is moderately alkaline. These horizons are calcareous.

The 2Cg horizon is brown, grayish brown, light brownish gray, gray, light gray, pale brown, very pale brown, yellowish brown, light yellowish brown, or brownish yellow. Mottles in shades of yellow and brown range from none to many. Texture is clay loam, sandy clay loam, or clay. Some pedons have a 2Cg horizon that has common, coarse nodules of calcium carbonate. Reaction is neutral to moderately alkaline. This horizon is typically noncalcareous but can range from noncalcareous to calcareous.

Aris Series

The Aris series consists of nearly level, somewhat poorly drained, nonsaline, loamy soils in upland areas. The surface is slightly convex. The slopes range from 0 to 1 percent.

Other associated soils are Edna, Kemah, Leton, and Verland soils. Edna, Leton, and Verland soils are in lower positions on the landscape than Aris soil. Kemah soils are in similar positions.

Typical pedon of Aris fine sandy loam; from Texas Farm Road 528 in Friendswood, 2.6 miles southeast on Farm Road 518, and 200 feet south, in a pasture:

A—0 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; few wormcasts; slightly acid; clear smooth boundary.

Eg—10 to 20 inches; grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; few fine roots; few fine pores; few wormcasts; few pockets of uncoated sand grains; slightly acid; clear smooth boundary.

Bg/E—20 to 32 inches; grayish brown (10YR 5/2) sandy clay loam, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very hard, firm, sticky and slightly plastic; few fine roots; about 25 percent tongues and interfingers of fine sandy loam; common pockets of uncoated sand; few fine dark concretions; neutral; clear wavy boundary.

Btg1—32 to 49 inches; light brownish gray (10YR 6/2) clay loam, light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few krotovina lined with grayish brown fine sandy loam; few medium dark concretions; neutral; gradual smooth boundary.

Btg2—49 to 62 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; many fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few medium dark concretions; few coarse pitted concretions of calcium carbonate; neutral.

The thickness of the solum is more than 70 inches. The combined thickness of the A and Eg horizons is 12 to 25 inches. Reaction is medium acid to neutral.

The A horizon is dark gray, dark grayish brown, or light brownish gray. Mottles in shades of red or brown range from few to common. This horizon is 4 to 10 inches thick.

The Eg horizon is dark grayish brown, grayish brown, light brownish gray, or light gray. Mottles in shades of brown, yellow, or gray range from few to common. This horizon is 6 to 18 inches thick.

The Bg/E horizon is dark gray, gray, or grayish brown. Mottles in shades of brown, red, or gray range from few to common. Texture is sandy clay loam, clay loam, or silty clay loam. Tongues and interfingers of fine sandy loam make up 15 to 35 percent of this horizon. Reaction is medium acid to neutral.

The Btg horizon is dark gray, gray, light brownish gray, or light gray. Mottles in shades of brown, yellow, or red range from few to common. Texture is clay, clay loam, or silty clay loam. The content of clay in the control section averages 35 to 50 percent. Reaction is medium acid to mildly alkaline. Pitted concretions of calcium carbonate are common at a depth of more than 40 inches.

Some pedons have a BCg horizon that is gray or light gray. Mottles in shades of brown, yellow, or red range from few to common. Texture is clay loam or silty clay loam. Reaction is medium acid to moderately alkaline. Typically, this horizon contains pitted concretions of calcium carbonate.

Aris soils are taxadjuncts to the Aris series because calcium carbonate concretions are in the lower part of the Bt horizon. However, this does not affect the use, behavior, and management of these soils.

Bacliff Series

The Bacliff series consists of nearly level, poorly drained, nonsaline, clayey soils in broad, upland areas. The surface is plane. The slopes range from 0 to 1 percent.

Other associated soils are Bernard, Edna, Lake Charles, Vamont, and Verland soils. All of these soils, except Vamont soils, are in slightly higher positions on the landscape than Bacliff soils. Vamont soils are in similar positions.

Typical pedon of Bacliff clay; from Texas Farm Road 518 in Kemah, 4 miles south on Texas Highway 146, 0.2 mile west on Farm Road 517, and 250 feet north, in rangeland:

A—0 to 9 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; many fine roots; common fine brown organic stains; medium acid; gradual wavy boundary.

Ag—9 to 35 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; strong coarse blocky structure parting to moderate fine blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few brown organic stains; common pressure faces; few medium intersecting slickensides in lower part; few medium dark concretions; neutral; gradual wavy boundary.

Bg1—35 to 48 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; common medium distinct yellowish brown (10YR 5/6) mottles; strong coarse blocky structure parting to moderate fine blocky structure; very hard, very firm, very sticky and plastic; few fine roots; common pressure faces; few intersecting slickensides; few medium dark concretions; neutral; gradual wavy boundary.

Bg2—48 to 63 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; many medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; strong coarse blocky structure parting to moderate medium blocky structure; very hard, very firm, very sticky and plastic; few intersecting slickensides; few medium and coarse pitted

concretions of calcium carbonate; few medium dark concretions; moderately alkaline.

The thickness of the solum is more than 60 inches. The 10- to 40-inch control section is 45 to 60 percent clay. Reaction in the control section is medium acid to moderately alkaline. When the soil is dry, cracks 1 inch to 2 inches wide extend from the surface into the Bg horizon, but cracks remain open for less than 90 cumulative days. Intersecting slickensides begin at a depth of about 10 to 30 inches. The lower part of the A horizon is cyclical and has an amplitude of 10 to 30 inches. Undisturbed areas have gilgai microrelief that has microknolls that are 6 to 15 inches higher than the microdepressions. Distance from the center of the microknolls to the center of the microdepressions is about 6 to 15 feet.

The A horizon is very dark gray, dark gray, or gray. In some pedons, the A horizon has a moist value of less than 3.5, but the layer is less than 12 inches thick in more than 60 percent of the pedon. Reaction ranges from medium acid to mildly alkaline. The thickness of the A horizon varies with the microrelief and ranges from 6 inches on the microknolls to about 45 inches in the microdepressions.

The B horizon is gray or light gray. Mottles in shades of yellow and brown range from few to many. Reaction is medium acid to mildly alkaline.

The Bg2 horizon is gray or light gray. Mottles in shades of yellow and brown range from few to a mottled matrix of gray, yellow, and brown. Reaction ranges from neutral to moderately alkaline. The lower part of this horizon typically has pitted, calcium carbonate concretions.

Bernard Series

The Bernard series consists of nearly level, somewhat poorly drained, nonsaline, loamy soils in upland areas. The surface is plane. The slopes range from 0 to 1 percent.

Other associated soils are Edna, Lake Charles, Mocarey, Morey, and Verland soils. These soils are on broad, plane landscapes. Edna and Verland soils are a lighter gray than Bernard soils. Lake Charles soils are clayey throughout. Mocarey and Morey soils have a less clayey subsoil than Bernard soils.

Typical pedon of Bernard clay loam; from Texas Highway 6 in Santa Fe, 4 miles south on Farm Road 646 to Farm Road 2004, 0.4 mile south on shell road, 250 feet east, and 200 feet south, in a cultivated field:

Ap—0 to 10 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very hard, very firm, sticky and plastic; common fine roots; common brown root stains; few wormcasts; slightly acid; clear wavy boundary.

BA—10 to 18 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few strong brown organic stains; few wormcasts; few shiny pressure faces; slightly acid; clear wavy boundary.

Btg1—18 to 40 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few pressure faces; few clay films on faces of peds; few medium black concretions; neutral; gradual wavy boundary.

Btg2—40 to 60 inches; gray (10YR 5/1) clay; light gray (10YR 6/1) dry; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few clay films on faces of peds; few medium black concretions; few fine pitted concretions of calcium carbonate; mildly alkaline; gradual wavy boundary.

BC—60 to 65 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very hard, very firm, very sticky and plastic; few medium pitted concretions of calcium carbonate; mildly alkaline.

The thickness of the solum ranges from 50 to more than 70 inches. The mollic epipedon is 16 to 40 inches thick. It is cyclical and has a horizontal spacing of 8 to 15 feet.

The A horizon is black, very dark gray, very dark grayish brown, or very dark brown. Reaction is medium acid to neutral.

The BA horizon is black, very dark gray, or dark gray. Texture is clay loam or clay. The clay content in this horizon is more than 35 percent. Reaction is medium acid to neutral.

The Btg horizon is black, very dark gray, dark gray, gray, very dark brown, very dark grayish brown, dark grayish brown, or grayish brown. Mottles of yellow or brown range from none to common. Texture is clay, clay loam, or silty clay. The clay content in this horizon ranges from 35 to 60 percent. Reaction is slightly acid to mildly alkaline. In many pedons, the Btg horizon has few calcium carbonate concretions at a depth of more than 36 inches.

Most pedons have a BC horizon. The BC horizon has colors that are similar to those in the Btg horizon but has values that are higher.

Some pedons have a C horizon that is gray, grayish brown, or brown; or it is mottled olive, yellow, and brown. Reaction is neutral to moderately alkaline.

Some pedons have a 2C horizon at a depth of 50 to 120 inches that is more red and is more sandy than the C horizon.

Caplen Series

The Caplen series consists of nearly level, very poorly drained, saline, loamy soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 0.5 percent. Caplen soils are in backwater areas and are covered by 2 to 12 inches of tidal water at some time each day.

Other associated soils are Placedo, Tatlum, and Tracosa soils. Placedo soils are in slightly higher positions on the landscape than Caplen soils. Placedo soils are not affected by daily tides. Tracosa soils are in slightly lower positions. These soils are flooded daily by tides. Also Placedo and Tracosa soils are more firm than Caplen soils. They have an *n* value of less than 0.7. Tatlum soils are less clayey than Caplen soils.

Typical pedon of Caplen mucky silty clay loam; from Texas Highway 124 in High Island, about 10 miles southwest on Texas Highway 87, about 3.2 miles northwest of Caplen to mouth of Sun Oil Company Canal, 0.6 mile southwest along shoreline of East Bay, and 250 feet south of East Bay, in a marsh:

Ag—0 to 10 inches; dark gray (10YR 4/1) mucky silty clay loam, gray (10YR 5/1) dry; massive; flows easily between fingers, leaves small residue in hand when squeezed (*n* value 1.2); slightly sticky and nonplastic; many fine and medium roots; estimated 35 percent hemic materials; estimated 10 percent fibric materials; strongly saline; moderately alkaline; abrupt smooth boundary.

Cg1—10 to 16 inches; dark gray (10YR 4/1) mucky silty clay loam, gray (10YR 5/1) dry; massive; flows easily between fingers, leaves small residue in hand when squeezed (*n* value 1.2); sticky and slightly plastic; many fine roots; estimated 20 percent hemic material; strongly saline; moderately alkaline; gradual smooth boundary.

Cg2—16 to 30 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; massive; flows easily between fingers, leaves small residue in hand when squeezed (*n* value 1.2); sticky and plastic; few fine roots; estimated 5 percent hemic material; strongly saline; neutral; gradual smooth boundary.

Cg3—30 to 35 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; massive; flows easily between fingers, leaves small residue in hand when squeezed (*n* value 1.2); sticky and plastic; few fine roots; strongly saline; neutral; gradual smooth boundary.

Cg4—35 to 50 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; common fine distinct brown (10YR 5/3) mottles; flows with difficulty between fingers, leaves large residue in hand when squeezed (*n* value 0.8); very sticky and slightly plastic; strongly saline; moderately alkaline; gradual smooth boundary.

Cg5—50 to 60 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; common medium distinct yellowish brown (10YR 5/6) and brown (10YR 5/3) mottles; massive; very hard, firm, very sticky and plastic; common fine and medium greenish gray concretions; strongly saline; moderately alkaline.

These soils have a peraquic moisture regime. An organic surface layer (O horizon) ranges from 0 to 14 inches thick. Reaction ranges from neutral to moderately alkaline throughout. The electrical conductivity ranges from 6 to 16 millimhos most of the year. The control section is 35 to 60 percent clay.

The Ag horizon is black, very dark gray, dark gray, or gray. It is 6 to 15 inches thick. Texture is clay, silty clay, silty clay loam, or their mucky analogs. Hemic and sapric material makes up as much as 15 percent of the Ag horizon. In a few pedons, the Ag horizon has mottles in shades of gray or greenish gray.

The Cg horizon is dark gray, gray, or light gray. Texture is clay, silty clay or silty clay loam. At a depth of more than 35 inches, texture is clay loam. In some pedons, the Cg horizon has strata of loam or sandy loam at a depth of more than 40 inches. Mottles in shades of gray and brown range from few to many.

The Caplen soils are taxadjuncts to the Caplen series because they have *n* value between 0.7 and 1.0 at a depth of more than 35 inches. However, this does not affect use, behavior, and management of these soils.

Cieno Series

The Cieno series consists of nearly level, poorly drained, nonsaline, loamy soils in slightly depressional, upland areas. The surface is concave. The slopes range from 0 to 1 percent.

Cieno soils and Mocarey soils are in a complex pattern. Cieno soils are in depressions or on the lower part of the landscape, and Mocarey soils are mainly in the smoother areas around and between the depressions.

Other associated soils are Algoa and Leton soils. Algoa soils are on low mounds. Leton soils are in the more conspicuous depressional areas.

Typical pedon of Cieno silt loam, in an area of Mocarey-Cieno complex; from Texas Farm Road 517 in Dickinson, 2.6 miles south on frontage road of U.S. Interstate 45, 0.15 mile west on shell road, 0.7 mile south southeast on field road beside canal, 0.3 mile southwest on field road beside the canal, and 880 feet east, in a cultivated field:

Ap—0 to 7 inches; dark gray (10YR 4/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; few

fine roots; few fine pores; few uncoated sand grains; few brown organic root stains; neutral; clear smooth boundary.

A1—7 to 11 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; few fine roots; few fine pores; few brown organic stains; few uncoated sand grains; neutral; clear wavy boundary.

Btg1—11 to 32 inches; gray (10YR 5/1) clay loam, light gray (10YR 6/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few uncoated sand seams less than 2 inches wide; few medium brown concretions; moderately alkaline; gradual smooth boundary.

Btg2—32 to 43 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few pockets of uncoated sand grains; few medium brown concretions; few coarse nodules of calcium carbonate; moderately alkaline; gradual smooth boundary.

Btg3—43 to 60 inches; light brownish gray (10YR 6/2) clay loam, light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few medium black concretions; moderately alkaline.

The thickness of the solum is more than 60 inches. Depth to free carbonates is 30 to about 45 inches. Few to common crayfish krotovinas are in many pedons. In many pedons, uncoated sand grains are on the faces of some peds. Interfingers of uncoated sand range from none to few throughout the argillic horizon and make up less than 5 percent of the matrix. Dark concretions up to 6 millimeters across range from none to few in the argillic horizon.

The A horizon is dark gray, gray, dark grayish brown, or grayish brown. Some pedons have a few brownish or yellowish mottles. The A horizon is 4 to 14 inches thick. Reaction ranges from medium acid to neutral.

The Btg1 horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, or light brownish gray. Brownish or yellowish mottles range from none to common. Texture is sandy clay loam or clay loam. The weighted average of the content of clay in the control section is 27 to 35 percent. Reaction ranges from slightly acid to moderately alkaline.

The Btg2 and Btg3 horizons are gray, light gray, grayish brown, or light brownish gray. Brownish or yellowish mottles range from few to common. Texture is sandy clay loam or clay loam. Pitted concretions of calcium carbonate range from few to common. Reaction is mildly alkaline or moderately alkaline.

The Cieno soils are taxadjuncts to the Cieno series because they have a silt loam surface layer and are believed to have mixed mineralogy. These differences do not affect the use, behavior, and management of these soils.

Edna Series

The Edna series consists of nearly level, poorly drained, nonsaline, loamy soils in upland areas. The surface is plane to slightly convex. The slopes range from 0 to 1 percent.

Other associated soils are Aris, Bernard, Kemah, Leton, Mocarey, Morey, and Verland soils. Aris and Kemah soils are in higher positions on the landscape than Edna soils. Bernard, Mocarey, Morey, and Verland soils are in slightly lower positions. Leton soils are in the depressional areas.

Typical pedon of Edna fine sandy loam; from Texas Highway 6 in Santa Fe, 4 miles south on Farm Road 646 to Farm Road 2004, 2.5 miles south on shell road, 2 miles southwest to south, and 250 feet northeast, in a pasture:

A—0 to 8 inches; dark gray (10YR 4/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; few strong brown root stains; slightly acid; abrupt smooth boundary.

Btg1—8 to 26 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; common fine roots; few medium dark concretions; few clay films on faces of peds; few very dark gray streaks on ped surfaces; few pressure faces; medium acid; gradual wavy boundary.

Btg2—26 to 45 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; common fine distinct light olive gray (5Y 6/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; few clay films on faces of peds; few fine dark concretions; few pressure faces; few dark gray streaks; neutral; gradual wavy boundary.

BC—45 to 60 inches; light brownish gray (2.5Y 6/2) clay, light gray (2.5Y 7/2) dry; many fine distinct yellowish brown (10YR 5/6) and common fine distinct gray (10YR 6/1) mottles; moderate coarse subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few medium dark concretions; moderately alkaline.

The thickness of the solum ranges from 60 inches to more than 80 inches. The soil cracks when dry, but the cracks rarely extend upward through the A horizon.

The A horizon is less than 10 inches thick in more than 50 percent of any pedon, but ranges from less than 10 to 16 inches thick. The horizon is dark gray, dark grayish brown, grayish brown, or light brownish gray. When this horizon is dry, it is massive and very hard or extremely hard. Reaction ranges from medium acid to neutral.

Some pedons have a thin discontinuous E horizon of higher value than the Ap or A horizon in the microlow.

The Btg horizon is dark gray, gray, light gray, dark grayish brown, or light brownish gray. Texture is typically clay but can include clay loam. The content of clay in the upper part of the Btg horizon ranges from 35 to 55 percent, and the content of silt ranges from 32 to 40 percent. Few or common, fine or medium, yellow, brown, red, and olive mottles are throughout the horizon. In some pedons, the Btg horizon has darker coatings on faces of peds. Reaction is medium acid to neutral. Coefficient of linear extensibility (COLE) ranges from 0.09 to 0.11.

Some pedons have a BC horizon that is mottled or has a grayish matrix that has few to common mottles in shades of olive, brown, yellow, or red. The dominant colors are gray, light gray, grayish brown, light brownish gray, brown, yellowish brown, pale brown, or light yellowish brown. Texture is commonly sandy clay loam or clay loam and less commonly clay or sandy clay. Pitted concretions, films, and threads of calcium carbonate range from none to common. Reaction ranges from slightly acid to moderately alkaline.

Follet Series

The Follet series consists of nearly level, very poorly drained, saline, loamy soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 0.5 percent. Follet soils are in broad, tidal areas and are covered by 2 to 12 inches of water at some time each day.

Other associated soils are Caplen, Placedo, Tracosa, and Veston soils. Caplen and Tracosa soils are in similar positions on the landscape as Follet soils but are more clayey. Also, Caplen soils are less firm than Follet soil and have an *n* value of more than 1. Placedo and Veston soils are in higher positions and are not affected by daily tides. Also, Placedo soils are more clayey than Follet soils.

Typical pedon of Follet loam; from Texas Highway 146 in the northwestern part of Texas City, 3 miles east on Loop 197, 0.9 mile east on paved road, 0.9 mile north, 0.1 mile east to levee, 0.8 mile north on levee, and 1,500 feet west-southwest of levee, in a marsh:

Ag—0 to 8 inches; gray (10YR 5/1) loam, light gray (10YR 6/1) dry; few fine distinct brownish yellow (10YR 6/8) mottles; massive; flows easily between fingers, leaves small residue in hand when squeezed; hard, firm, slightly sticky and slightly plastic; common fine roots; few strong brown organic stains; very strongly saline; mildly alkaline; clear smooth boundary.

Cg1—8 to 40 inches; light gray (10YR 7/1) loam, white (10YR 8/1) dry; common fine distinct brownish yellow (10YR 6/8) mottles; massive; very hard, firm, sticky and plastic; few fine and medium roots; few thin discontinuous sand strata; few fine brown concretions; very strongly saline; moderately alkaline; gradual boundary.

Cg2—40 to 60 inches; light gray (10YR 7/1) clay loam, white (10YR 8/1) dry; many fine distinct brownish yellow (10YR 6/8) mottles; massive; very hard, firm, sticky and plastic; few fine roots; few fine pitted concretions of calcium carbonate; very strongly saline; moderately alkaline.

These soils have a peraquic moisture regime. In some pedons, these soils have a surface layer that has an *n* value of more than 0.7, but it does not extend to a depth of 20 inches. In some pedons, these soils have a peaty or mucky surface layer 2 to 8 inches thick. Reaction ranges from neutral to moderately alkaline throughout. The electrical conductivity ranges from 16 to 60 millimhos, and the exchangeable sodium is more than 15 percent throughout the control section.

The Ag horizon is very dark gray, dark gray, gray, light gray, very dark grayish brown, light grayish brown, grayish brown, or light brownish gray. If the horizon has value of 3, it is less than 10 inches thick. Mottles in shades of gray, yellow, and brown range from none to common. This horizon is 4 to 15 inches thick.

The Cg horizon is dark gray, gray, or white. Mottles in shades of gray, brown, or yellow range from none to common. In some pedons, the Cg horizon has few to common black or brown concretions. Texture is loam, sandy clay loam, silty clay loam, or clay loam. In most pedons, this horizon is stratified.

Francitas Series

The Francitas series consists of nearly level, poorly drained, saline, clayey soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 1 percent.

Other associated soils are Bernard, Harris, Lake Charles, Narta, Placedo, and Verland soils. Bernard, Lake Charles, and Verland soils are in higher positions on the landscape than Francitas soils. These soils are on the uplands. Harris and Placedo soils are in lower positions. Narta soils are in similar positions as Francitas soils but have a loamy surface layer.

Typical pedon of Francitas clay; from Texas Farm Road 1764 in Texas City, 3 miles north on Texas Highway 146, and 100 feet east, in a pasture:

A1—0 to 13 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine faint dark grayish brown mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; common fine roots; few shiny ped surfaces; slightly saline; moderately alkaline; gradual wavy boundary.

A2—13 to 36 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few shiny pressure faces; few intersecting slickensides; few medium pitted concretions of calcium carbonate; moderately saline; moderately alkaline; gradual wavy boundary.

Bg1—36 to 48 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few intersecting slickensides; few medium black concretions; moderately saline; moderately alkaline; gradual wavy boundary.

Bg2—48 to 60 inches; light brownish gray (10YR 6/2) clay, light gray (10YR 7/2) dry; common fine prominent brownish yellow (10YR 6/6) mottles; moderate medium blocky structure; very hard, very firm, very sticky and plastic; common fine pitted concretions of calcium carbonate; common fine black concretions; moderately saline; moderately alkaline; gradual wavy boundary.

Bg3—60 to 73 inches; mottled light gray (N 7/0) and brownish yellow (10YR 6/8) clay; moderate medium blocky structure; very hard, very firm, very sticky and plastic; few fine soft black bodies; few fine pitted concretions of calcium carbonate; moderately saline; moderately alkaline.

The thickness of the solum ranges from 40 to more than 80 inches. The average content of clay in the 10- to 40-inch control section ranges from 45 to 60 percent. Intersecting slickensides begin at a depth of about 10 to 30 inches. Undisturbed areas have gilgai microrelief that has microknolls that are 3 to 10 inches higher than the microdepressions. Salinity increases with depth. The conductivity of the saturation extract ranges from 1 to 4 millimhos per centimeter in the A1 or Ap horizons, 4 to 12 millimhos per centimeter in the A2 horizon, and 8 to 25 millimhos per centimeter in the Bg horizon. In some part of the 10- to 40-inch control section, the exchangeable sodium exceeds 15 percent.

The A1 horizon is black or very dark gray. This horizon is 6 to 20 inches thick. Reaction ranges from slightly acid to moderately alkaline.

The A2 horizon is black, very dark gray, or dark gray. This horizon is 10 to 24 inches thick. Texture is clay or silty clay. The content of clay in this horizon ranges from 40 to 60 percent. Reaction ranges from neutral to moderately alkaline.

The Bg horizon is dark gray, gray, light gray, very dark grayish brown, dark grayish brown, grayish brown, brown, pale brown, or light brownish gray. Mottles in shades of brown or yellow range from none to common. Texture is clay or silty clay. Reaction is mildly alkaline or moderately alkaline.

Some pedons have a C horizon that is gray, light gray, grayish brown, light brownish gray, brown, pale brown, or very pale brown. Texture is clay, silty clay, clay loam, or silty clay loam.

The Bg and C horizons have pitted concretions of calcium carbonate in most pedons.

Galveston Series

The Galveston series consists of nearly level to undulating, somewhat excessively drained, nonsaline, sandy soils in coastal areas. The surface is convex. The slopes range from 0 to 4 percent.

Other associated soils are Mustang and Nass soils. These soils are in lower positions on the landscape than Galveston soils. Mustang soils are poorly drained, and Nass soils are very poorly drained.

Typical pedon of Galveston fine sand, undulating; from Texas Spur 342 in Galveston, 9 miles southwest on Farm Road 3005 to Stewart Road, 3.8 miles southwest on Farm Road 3005, and 400 feet northwest of the fence, in rangeland:

A—0 to 6 inches; grayish brown (10YR 5/2) fine sand, light brownish gray (10YR 6/2) dry; single grained; loose, nonsticky and nonplastic; few fragments of marine shells 1 millimeter to 2 millimeters in size; nonsaline; neutral; clear wavy boundary.

C1—6 to 12 inches; pale brown (10YR 6/3) fine sand, very pale brown (10YR 8/3) dry; single grained; loose, nonsticky and nonplastic; common fine roots; few fragments of marine shells 1 millimeter to 2 millimeters in size; nonsaline; mildly alkaline; clear smooth boundary.

C2—12 to 30 inches; dark grayish brown (10YR 4/2) fine sand, light brownish gray (10YR 6/2) dry; single grained; loose, nonsticky and nonplastic; few fine roots; nonsaline; mildly alkaline; clear wavy boundary.

C3—30 to 60 inches; very pale brown (10YR 7/3) fine sand, very pale brown (10YR 8/3) dry; common fine distinct yellowish brown (10YR 5/4) mottles; single grained; loose, nonsticky and nonplastic; nonsaline; mildly alkaline.

Depth to loamy strata is more than 72 inches. The 10- to 40-inch control section is fine sand or sand. The

content of silt and clay is less than 10 percent. Reaction is medium acid to moderately alkaline.

The A horizon is fine sand or loamy fine sand.

These soils are gray, light gray, grayish brown, light brownish gray, brown, pale brown, or very pale brown throughout.

In many pedons, the underlying material has brownish mottles at a depth of more than 30 inches. In some pedons, the underlying material has strata that contain many shell fragments.

The Galveston soils in map units Gs and Nx are taxadjuncts to the Galveston series because they have shell fragments in the underlying material and have a dark surface layer. However, this does not affect the use, behavior, and management of these soils.

Harris Series

The Harris series consists of nearly level, very poorly drained, saline, clayey soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 0.5 percent. These soils are flooded at times by storm tides and are saturated most of the time.

Other associated soils are Francitas, Narta, Placedo, Tracosa, and Veston soils. Francitas, Narta, and Veston soils are in higher positions on the landscape than Harris soils; Placedo soils are in similar positions; and Tracosa soils are in slightly lower positions. Also Tracosa soils are flooded daily by tides.

Typical pedon of Harris clay; from Texas Highway 6 in Santa Fe, about 4 miles south on Farm Road 646 to Farm Road 2004, 2.5 miles south on shell road, 2.1 miles east-southeast, and 25 feet north, in rangeland:

Ag1—0 to 6 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very hard, very firm, sticky and very plastic; many fine roots; common strong brown organic stains; moderately saline; neutral; gradual smooth boundary.

Ag2—6 to 13 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very hard, very firm, sticky and very plastic; few fine roots; few strong brown organic stains; strongly saline; moderately alkaline; gradual smooth boundary.

Bg1—13 to 38 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; few fine distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; very hard, very firm; sticky and very plastic; few fine roots; few medium brown concretions; few medium pitted concretions of calcium carbonate; strongly saline; moderately alkaline; clear wavy boundary.

Bg2—38 to 60 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; few fine faint light gray mottles; medium coarse angular blocky structure; very hard, very firm, sticky and very plastic; few fine brown concretions; few medium pitted concretions of calcium carbonate; strongly saline; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. The content of clay in the 10- to 40-inch control section ranges from 40 to 60 percent. The soil is saturated to the surface for 4 to 8 months and seldom dries to below field capacity. Soil salinity ranges from slight to strong. Reaction ranges from neutral to strongly alkaline throughout. The upper 20 inches of the Bg horizon has less than 15 percent saturation with exchangeable sodium, or the saturation with exchangeable sodium is constant or increases below a depth of 20 inches.

The Ag horizon is black or very dark gray. Mottles in shades of brown or yellow range from none to common. Some pedons have an organic surface layer less than 4 inches thick. The thickness of the Ag horizon ranges from 10 to 24 inches. The content of organic matter ranges from 2 to 15 percent, and it is higher in the upper part of the horizon.

The Bg horizon is dark gray, gray, or light gray. Mottles in shades of gray, yellow, and brown range from few to common. Texture is clay or silty clay.

Some pedons have a C horizon that is similar to the Bg horizon in color and texture.

Ijam Series

The Ijam series consists of nearly level to strongly sloping, poorly drained, saline, clayey soils in coastal marsh areas. These soils formed in materials dredged from bays and canals. The surface is plane to convex. The slopes range from 0 to 8 percent.

Other associated soils are Follet, Placedo, Tracosa, and Veston soils. These soils are in lower positions on the landscape than Ijam soils. Unlike Ijam soils, these soils did not form in dredged material.

Typical pedon of Ijam clay, 0 to 2 percent slopes; from the intersection of U.S. Interstate 45 and Texas Spur 342 in Galveston, 0.9 mile east on U.S. Highway 75, 3.9 miles northeast on 51st Street, across Galveston Channel onto Pelican Island, and 200 feet south of road, in rangeland:

A—0 to 10 inches; dark grayish brown (10YR 4/2) clay, grayish brown (10YR 5/2) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; very hard, very firm, very sticky and plastic; common fine and medium roots; few brown root stains; few fine pores; few oyster shell fragments; calcareous; moderately saline; moderately alkaline; gradual smooth boundary.

Cg1—10 to 35 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common fine distinct dark yellowish brown (10YR 4/4) and dark gray (N 4/0) mottles,

few fine distinct gray (10YR 5/1) mottles; massive; very hard, very firm, very sticky and plastic; few fine roots; some dark grayish brown material from the A horizon; few thin seams of discontinuous sand strata in small cracks; calcareous; moderately saline; moderately alkaline; gradual smooth boundary.

Cg2—35 to 56 inches; gray (10YR 5/1) clay, gray (10YR 6/1) dry; common fine distinct dark gray (N 4/0) mottles; massive; very hard, very firm, very sticky and plastic; few fine roots; few thin discontinuous sand strata; few sand-size shell fragments; moderately saline; moderately alkaline; gradual smooth boundary.

2Cg—56 to 61 inches; bluish gray (5B 6/1) sand, light bluish gray (5B 7/1) dry; single grained; loose, nonsticky and nonplastic; few thin discontinuous sandy clay loam strata; few small oyster shell fragments; moderately saline; neutral.

These soils are saturated for 3 to 6 months. Reaction ranges from neutral to strongly alkaline throughout. Some layers are calcareous, but carbonates are not continuous between depths of 10 and 20 inches. Salinity ranges from 4 to 16 millimhos throughout.

The A horizon is light gray, gray, dark gray, or dark grayish brown. It is 2 to 10 inches thick.

The Cg horizon is dark gray, gray, light brownish gray or bluish gray. Mottles and streaks of yellowish brown or strong brown are few to common. The 10- to 40-inch control section is 40 to 50 percent clay. Pockets, lenses, or thin sandy or loamy sediment strata occur at random throughout the horizon.

Some pedons have a 2Cg horizon that is stratified sand, loamy sand, sandy loam, or sandy clay loam. Colors in the 2Cg horizon are similar to those in the Cg horizon.

Karankawa Series

The Karankawa series consists of nearly level, very poorly drained, saline, loamy soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 0.5 percent. Karankawa soils are inundated daily by tides.

Other associated soils are Follet, Mustang, and Nass soils. Follet soils are in similar positions on the landscape as Karankawa soils. Mustang and Nass soils are in higher positions.

Typical pedon of Karankawa mucky loam; about 7.5 miles west of Texas Spur 342 in Galveston to the intersection of Eckert Bayou and West Bay, 3,300 feet on a compass heading of 52 degrees to Starvation Cove, and 300 feet south, in an area used as habitat for wildlife:

Ag1—0 to 10 inches; dark gray (10YR 4/1) mucky loam, light gray (10YR 6/1) dry; massive; flows easily between fingers, leaves small residue in hand when squeezed; hard, friable, slightly sticky and nonplastic; many coarse roots; estimated 20 percent organic matter; strongly saline; moderately alkaline; clear smooth boundary.

Ag2—10 to 18 inches; dark gray (10YR 4/1) mucky fine sandy loam, light gray (10YR 6/1) dry; massive; flows easily between fingers, leaves small residue in hand when squeezed; hard, friable, slightly sticky and nonplastic; many fine roots; estimated 15 percent organic matter; strongly saline; moderately alkaline; clear smooth boundary.

Cg1—18 to 24 inches; light gray (10YR 6/1) fine sandy loam, light gray (10YR 7/1) dry; common fine and medium faint gray mottles, few medium distinct brown (10YR 5/3) mottles; massive; slightly hard, friable, nonsticky and nonplastic; few fine roots; strongly saline; moderately alkaline; gradual smooth boundary.

Cg2—24 to 30 inches; light gray (10YR 6/1) fine sandy loam, light gray (10YR 7/1) dry; common fine and medium faint gray mottles; massive; hard, friable, nonsticky and nonplastic; few fine and coarse black organic streaks; strongly saline; moderately alkaline; clear smooth boundary.

Cg3—30 to 38 inches; light gray (N 6/0) fine sandy loam, light gray (N 7/0) dry; common fine and medium distinct gray (10YR 6/1) and light gray (10YR 7/1) mottles, and fine medium distinct greenish gray (5BG 5/1) and dark greenish gray mottles, few fine distinct dark greenish gray (5G 5/2) mottles; massive; hard, friable, nonsticky and nonplastic; few fine and medium dark gray organic streaks; few fine and medium pitted greenish gray concretions of calcium carbonate; strongly saline; moderately alkaline; gradual smooth boundary.

Cg4—38 to 60 inches; light gray (N 6/0) loamy fine sand, light gray (N 7/0) dry; few fine distinct greenish gray (5BG 5/1) mottles, common fine distinct dark greenish gray (5G 4/1) and yellowish brown (10YR 5/6) mottles, common fine and medium faint gray and light gray mottles; single grained; loose, nonsticky and nonplastic; few fine dark gray organic streaks; few medium pitted greenish gray concretions of calcium carbonate; strongly saline; moderately alkaline.

These soils have a peraquic moisture regime. Typically, the surface layer has an *n* value of more than 0.7 but is less than 20 inches thick. The surface layer typically is 10 to 20 percent organic matter. Reaction is neutral to moderately alkaline throughout. The electrical conductivity ranges from 20 to 60 millimhos per centimeter, and the exchangeable sodium ranges from 5 to more than 15 percent throughout.

The Ag horizon is very dark gray, dark gray, gray, light gray, very dark grayish brown, dark grayish brown, grayish brown, or light brownish gray. Mottles in shades

of gray, yellow, brown, and green range from none to many.

The Cg horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, light brownish gray, dark greenish gray, greenish gray, or light greenish gray. Mottles in shades of gray, yellow, brown, and green range from none to many. Gray organic stained seams range from none to common. Texture ranges from loamy very fine sand to loam, and at a depth of more than 35 inches, it is loamy fine sand. Typically, this horizon has few to common gray, brown, black, or green concretions, some of which are calcareous.

Kemah Series

The Kemah series consists of nearly level to gently sloping, somewhat poorly drained, nonsaline, loamy soils in upland areas. The surface is plane to slightly convex. The slopes range from 0 to 3 percent.

Other associated soils are Aris, Bernard, Edna, Leton, and Verland soils. Aris soils are in similar positions on the landscape as Kemah soils. Bernard, Edna, and Verland soils are in lower positions. Leton soils are in the low, depressional areas.

Typical pedon of Kemah silt loam, 0 to 1 percent slopes; from U.S. Interstate 45 in Dickinson, 5.9 miles east on Texas Farm Road 517, 1.1 miles south on Texas Highway 146, 100 feet east on paved road that goes under Dickinson Bayou bridge, and 50 feet east, in a pasture:

A—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; hard, friable, nonsticky and nonplastic; many fine and medium roots; common fine pores; few yellowish brown organic stains; medium acid; abrupt smooth boundary.

E—10 to 15 inches; grayish brown (10YR 5/2) loam, light brownish gray (10YR 6/2) dry; few fine distinct dark red (2.5YR 3/6) mottles; weak medium subangular blocky structure; hard, friable, nonsticky and nonplastic; few fine roots; common fine pores; dark grayish brown material from the A horizon; strongly acid; abrupt wavy boundary.

Btg1—15 to 24 inches; mottled dark gray (10YR 4/1) and grayish brown (10YR 5/2) clay; many fine prominent dark red (2.5YR 3/6) and yellowish brown (10YR 5/6) mottles; moderately fine subangular blocky structure; very hard, very firm, sticky and plastic; few fine roots; few patchy clay films on faces of peds; few dark gray streaks; few fine dark concretions; medium acid; gradual wavy boundary.

Btg2—24 to 38 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles, few fine distinct dark red (2.5YR 3/6) mottles; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; few fine roots; dark grayish brown streaks from overlying horizons; few shiny ped surfaces; few patchy clay films on faces of peds; few fine dark concretions; medium acid; gradual wavy boundary.

Btg3—38 to 60 inches; grayish brown (2.5YR 5/2) sandy clay loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; few fine roots; few shiny ped surfaces; few patchy clay films on faces of peds; few medium dark concretions; neutral.

The combined thickness of the A and E horizons ranges from 10 to 22 inches in over 60 percent of the pedon. The thickness of the solum is more than 50 inches. Typically, the boundary between the E and B horizons is abrupt but is clear in places.

The A horizon is very dark gray, dark gray, gray, very dark grayish brown, dark grayish brown, grayish brown, dark brown, or brown. The thickness of this horizon ranges from 4 to 22 inches. If the A horizon has value of 3, the thickness is less than 7 inches. Reaction is strongly acid through neutral.

Some pedons have an E horizon that is gray, light gray, grayish brown, or light brownish gray. The E horizon is 0 to 18 inches thick. Texture is silt loam, loam, or fine sandy loam. Reaction is strongly acid to neutral.

The Btg horizon is dark gray, gray, light gray, light grayish brown, grayish brown, or light brownish gray. Mottles in shades of yellow, brown, or red range from few to many. Texture is clay, clay loam, or sandy clay loam. Pitted, calcium carbonate concretions range from none to few in the Btg1 and Btg2 horizons and range from none to common in the Btg 3 horizon. Reaction of the Btg horizon is medium acid to mildly alkaline. In some pedons, the Btg3 horizon ranges from medium acid to moderately alkaline. The Btg3 horizon has a calcareous matrix.

A C or 2C horizon is within a depth of 80 inches in places. The C or 2C horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, light brownish gray, brown, pale brown, dark yellowish brown, yellowish brown, light yellowish brown, very pale brown, brownish yellow, or yellow. Mottles in shades of yellow and brown range from none to many. Texture is clay loam, sandy clay loam, clay, or silty clay loam. In some pedons, the C or 2C horizon has few to common pitted concretions of calcium carbonate. Reaction is neutral to moderately alkaline. The C or 2C horizon is noncalcareous.

Lake Charles Series

The Lake Charles series consists of nearly level to gently sloping, somewhat poorly drained, nonsaline, clayey soils in broad, upland areas. The surface is plane. The slopes range from 0 to 5 percent.

Other associated soils are Bacliff, Bernard, Francitas, Vamont, and Verland soils. Bacliff soils are in slightly

lower positions on the landscape than Lake Charles soils. Bernard and Verland soils are in slightly higher positions. Francitas soils are in slightly lower positions. These soils are in the coastal marsh. Vamont soils are in similar positions as Lake Charles soils.

Typical pedon of Lake Charles clay, 0 to 1 percent slopes; from Texas Highway 146 in Texas City, 2.1 miles west on Farm Road 1764, 1.9 miles northwest on Texas Highway 3, 1 mile northeast and north on county road, 600 feet east, and 20 feet south of road, in rangeland:

A1—0 to 12 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; common fine roots; few brown organic stains; few shiny pressure faces; few medium brown concretions; medium acid; gradual wavy boundary.

A2—12 to 24 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate coarse blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; few pressure faces; few fine intersecting slickensides; few fine brown concretions; neutral; gradual wavy boundary.

Bg1—24 to 51 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; few pressure faces; few fine intersecting slickensides; few medium black concretions; mildly alkaline; gradual wavy boundary.

Bg2—51 to 62 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium blocky structure; extremely hard, very firm, very sticky and plastic; few pressure faces; few medium black concretions; few medium pitted concretions of calcium carbonate; moderately alkaline.

The thickness of the solum ranges from 50 to more than 80 inches. The 10- to 40-inch control section contains 45 to 60 percent clay and more than 28 percent silt. When the soils are dry, cracks 1 inch to 2 inches wide extend from the surface into the Bg horizon during dry summers. Intersecting slickensides begin at a depth of about 10 to 30 inches. The lower part of the A horizon is cyclic and has an amplitude of 20 to 35 inches. Undisturbed areas have gilgai microrelief that has microknolls that are 6 to 15 inches higher than the microdepressions. Distance from the center of the microknoll to the center of the microdepression is about 8 to 16 feet.

The A horizon is black or very dark gray. Mottles in shades of yellow or brown range from none to common. Reaction is medium acid to mildly alkaline. The thickness of the A horizon varies with the microrelief and ranges from 6 to 20 inches on the microknolls and from 20 to 50 inches in the microdepression. The thickness of the A horizon averages more than 12 inches in more than 60 percent of the pedon.

The Bg horizon is very dark gray, dark gray, or gray. Mottles in shades of red, brown, or yellow range from none to common. Reaction is neutral to moderately alkaline. In some pedons, this horizon is calcareous. Pitted concretions of calcium carbonate range from none to common.

Some pedons have a 2C horizon that is commonly at a depth of 50 inches to more than 100 inches.

Leton Series

The Leton series consists of nearly level, poorly drained, nonsaline, loamy soils on the uplands in depressional areas. The surface is concave. The slopes range from 0 to 1 percent.

Other associated soils are Algoa, Aris, Cieno, Edna, Kemah, and Mocarey soils. These soils are in higher positions on the landscape than Leton soils. Cieno soils are also in depressional areas, but the depressions are more shallow than those of the Leton soils.

Typical pedon of Leton loam; from Texas Farm Road 1266 north of Dickinson, 0.4 mile west on Farm Road 646, 200 feet north on private road, and 150 feet east, in a pasture:

A—0 to 5 inches; dark gray (10YR 4/1) loam, gray (10YR 5/1) dry; weak medium granular structure; hard, friable, nonsticky and nonplastic; common fine and medium roots; common fine pores; few yellowish brown organic stains; neutral; abrupt smooth boundary.

Eg—5 to 12 inches; gray (10YR 5/1) loam, light gray (10YR 6/1) dry; weak medium subangular blocky structure; hard, friable, nonsticky and nonplastic; few fine roots; few fine pores; few yellowish brown organic stains; few uncoated sand grains; neutral; abrupt smooth boundary.

B/E—12 to 26 inches; gray (10YR 5/1) clay loam, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; about 20 percent tongues of gray loam 2 inches wide; few fine black concretions; neutral; clear wavy boundary.

Btg—26 to 60 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; many fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; few fine roots; few gray streaks from overlying horizon; few medium dark concretions; few fine pitted concretions of calcium carbonate; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. The content of sand throughout the solum is more than 10 percent. It is mostly very fine

sand. Reaction of the A and E horizons ranges from strongly acid to neutral.

The A horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, or light grayish brown. It is 3 to 7 inches thick.

The E horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, or light brownish gray. The thickness of this horizon ranges from 6 to 23 inches. Texture is silt loam, loam, or very fine sandy loam. Mottles in shades of brown or gray range from none to common. Brown organic stains are in many pedons. In many pedons, the E horizon has seams of uncoated sand grains less than 0.5 millimeter wide.

The B/E horizon is silt loam, loam, or very fine sandy loam in the E part and loam, sandy clay loam, clay loam, or silty clay loam in the B part. The content of clay in the upper 20 inches of this horizon is 18 to 35 percent. This horizon also is less than 15 percent fine to coarse sand. The E part occurs as tongues that penetrate about 35 inches in the B part of this horizon. These tongues make up 15 to 40 percent of the horizon. The E part of this horizon is gray, light gray, white, grayish brown, or light brownish gray. The B part is dark gray, gray, light gray, dark grayish brown, grayish brown, or light brownish gray. Mottles in shades of brown and gray are few and common. Reaction ranges from medium acid to mildly alkaline.

The Btg horizon is gray, light gray, white, grayish brown, or light brownish gray. Mottles in shades of brown, yellow, or gray range from few to common. Texture is loam, sandy clay loam, clay loam, or silty clay loam. Reaction ranges from medium acid to moderately alkaline.

Some pedons have a Cg horizon that is gray, light gray, grayish brown, or light brownish gray. Mottles in shades of brown or gray range from none to common. Texture ranges from loam to clay. Reaction ranges from medium acid to moderately alkaline.

Mocarey Series

The Mocarey series consists of nearly level, somewhat poorly drained, nonsaline, loamy soils in upland areas. The overall surface is generally slightly convex and commonly has some mounds. The slopes range from 0 to 1 percent; although, short slopes associated with mounds are about 3 percent.

Other associated soils are Algoa, Bernard, Cieno, Edna, Leton, Morey, and Verland soils. Algoa and Edna soils generally are in slightly higher positions on the landscape than Mocarey soils; Bernard and Verland soils are in slightly lower positions; and Morey soils are in similar positions. Cieno and Leton soils are in lower, concave, depressional areas.

Typical pedon of Mocarey loam; from U.S. Interstate 45 north of LaMarque, 0.8 mile east on Farm Road 1764, 0.5 mile south on paved road, and 200 feet east of road, in a pasture:

A—0 to 12 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; few wormcasts; few snail shell fragments; mildly alkaline; clear smooth boundary.

Bw—12 to 22 inches; dark gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; common fine distinct pale brown (10YR 6/3) and grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine roots; few fine pores; few fine pitted concretions of calcium carbonate; few medium black concretions; moderately alkaline; gradual smooth boundary.

Bk1—22 to 38 inches; light gray (10YR 7/2) loam, white (10YR 8/2) dry; weak coarse subangular blocky structure; hard, friable, nonsticky and nonplastic; few fine roots; 30 percent soft masses of calcium carbonate; 40 percent calcium carbonate equivalent; moderately alkaline; calcareous; gradual smooth boundary.

Bk2—38 to 52 inches; light gray (10YR 6/1) loam, light gray (10YR 7/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine roots; common fine pitted calcium carbonate concretions in pockets and seams; 5 percent threads of calcium carbonate; 20 percent calcium carbonate equivalent; few medium black concretions; moderately alkaline; calcareous; gradual smooth boundary.

2C—52 to 60 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; many fine prominent yellowish brown (10YR 5/6, 5/8) mottles; massive; very hard, very firm, sticky and plastic; few medium pitted concretions of calcium carbonate; few medium dark concretions; moderately alkaline.

The thickness of the solum ranges from 36 to more than 60 inches. Some pedons have few black concretions 2 to 4 millimeters in diameter. Depth to horizons that has secondary carbonates that have 5 to 60 percent calcium carbonate equivalent ranges from 17 to 30 inches, but the control section does not average more than 40 percent. The silicate clay content in the control section ranges from 18 to 35 percent.

The A horizon is black, very dark gray, very dark brown, or very dark grayish brown. The A horizon is 7 to 13 inches thick. Texture is loam or silty clay loam. Reaction is slightly acid to moderately alkaline.

The Bw horizon is very dark gray, dark gray, gray, light gray, very dark grayish brown, dark grayish brown, grayish brown, or light brownish gray. In most pedons, the Bw horizon has mottles in shades of brown and

yellow. Texture is loam, silty clay loam, or clay loam. Reaction ranges from mildly alkaline to moderately alkaline.

The Bk horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, light brownish gray, brown, pale brown, or very pale brown. Mottles in shades of brown range from none to common. Texture is loam, clay loam, or silty clay loam. Reaction is moderately alkaline. This horizon is typically calcareous.

The 2C horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, light brownish gray, brown, pale brown, very pale brown, dark yellowish brown, yellowish brown, light yellowish brown, brownish yellow, or yellow. Mottles in shades of yellow and brown range from few to many. Texture is clay loam, sandy clay loam, or clay. Some pedons have a 2C horizon that has common coarse nodules of calcium carbonate. Reaction is neutral to moderately alkaline.

Morey Series

The Morey series consists of nearly level, poorly drained, nonsaline, loamy soils in upland areas. The surface is plane to slightly convex. The slopes range from 0 to 1 percent.

Other associated soils are Aris, Bernard, Edna, Kemah, Mocarey, and Verland soils. Aris, Edna, and Kemah soils are in slightly higher positions on the landscape than Morey soils; Bernard and Verland soils are in slightly lower positions; and Mocarey soils are in similar positions.

Typical pedon of Morey silt loam; from Texas Farm Road 517 in Dickinson, 1.9 miles southeast on Texas Highway 3 to Farm Road 2004, 0.8 mile southeast on Texas Highway 3, 0.5 mile northeast to north on shell road, and 50 feet east of road, in a pasture:

A—0 to 9 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry, weak fine subangular blocky structure; hard, friable, nonsticky and nonplastic; common fine roots; common fine pores; few strong brown root stains; few wormcasts; medium acid; clear smooth boundary.

BA—9 to 11 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure; hard, friable, nonsticky and nonplastic; few fine roots; few fine pores; few brown organic stains; medium acid; clear smooth boundary.

Btg1—11 to 28 inches; dark gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; few fine distinct yellowish brown mottles; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few medium pitted concretions of calcium carbonates; few fine dark concretions; neutral; gradual smooth boundary.

Btg2—28 to 43 inches; gray (10YR 5/1) clay loam, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few medium pitted concretions of calcium carbonate; few medium dark concretions; neutral; gradual smooth boundary.

Btg3—43 to 60 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few medium dark concretions; mildly alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The mollic epipedon is 10 to 20 inches thick.

The A and BA horizons are black, very dark gray, very dark brown, or very dark grayish brown. Texture is silt loam or loam. Reaction ranges from medium acid to neutral.

The Btg1 horizon is dark gray or gray. Mottles in shades of brown range from few to common. Texture is silty clay loam or clay loam. The content of clay in this horizon is 25 to 35 percent; of silt, 40 to 50 percent; and of sand, 15 to 35 percent. Less than 15 percent of the sand is fine sand and coarser sand. Reaction ranges from medium acid to mildly alkaline.

The Btg2 and Btg3 horizons are gray, light gray, grayish brown, or light brownish gray. Mottles in shades of brown range from few to many. Texture is silty clay loam or clay loam. Reaction ranges from slightly acid to moderately alkaline. In many pedons, these horizons contain concretions of calcium carbonate but do not exceed 5 percent calcium carbonate equivalent within a depth of 30 inches.

Mustang Series

The Mustang series consists of nearly level to gently sloping, poorly drained, nonsaline to saline, sandy soils in coastal areas. The surface is plane to slightly convex. The slopes range from 0 to 3 percent.

Other associated soils are Galveston, Karankawa, Nass, Sabine, and Veston soils. Galveston and Sabine soils are in higher positions on the landscape than Mustang soils, and Karankawa and Veston soils are in lower positions. Nass soils are in the low, depressional areas.

Typical pedon of Mustang fine sand; from Texas Spur 342 in Galveston, 9 miles southwest on Farm Road 3005 to Stewart Road, 3.8 miles southwest on Farm Road 3005, 0.15 mile northwest on shell road, and 200 feet southwest of the fence, in rangeland:

A—0 to 3 inches; dark gray (10YR 4/1) fine sand, gray (10YR 5/1) dry; single grained; loose, nonsticky and nonplastic; many fine and few medium roots; mildly alkaline; nonsaline; abrupt smooth boundary.

Cg1—3 to 7 inches; grayish brown (10YR 5/2) fine sand, light gray (10YR 7/2) dry; many medium prominent yellowish brown (10YR 5/4) mottles, common medium distinct dark brown (10YR 4/3) mottles, few fine faint pale brown mottles; single grained; loose, nonsticky and nonplastic; few fine roots; common sand-size shell fragments; nonsaline; moderately alkaline; clear wavy boundary.

Cg2—7 to 60 inches; gray (10YR 5/1) fine sand, light gray (10YR 7/1) dry; single grained; loose, nonsticky and nonplastic; common sand-size shell fragments; nonsaline; moderately alkaline.

Depth to loamy strata or to layers of marine shells is 40 to more than 100 inches. The soil is rarely, if ever, at the wilting point at a depth of more than 10 inches, and it is saturated for several days or for weeks following heavy rains. The 10- to 40-inch control section is fine sand and contains less than 10 percent silt and clay. Coarse fragments of marine shells and shell fragments make up less than 15 percent, by volume, of Mustang soils. Reaction ranges from neutral to moderately alkaline. Salinity ranges from saline to nonsaline.

The A horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, or light grayish brown.

The Cg horizon is gray, light gray, white, grayish brown, or light brownish gray. Mottles in shades of brown or yellow range from few to common.

Narta Series

The Narta series consists of nearly level, somewhat poorly drained, saline, loamy soils on low uplands near the coastal marsh. The surface is plane. The slopes range from 0 to 1 percent.

Other associated soils are Bacliff, Bernard, Edna, Follet, Francitas, Lake Charles, Placedo, Tracosa, and Verland soils. Bacliff, Bernard, Edna, Lake Charles, and Verland soils are in slightly higher positions on the landscape than Narta soils. Follet, Placedo, and Tracosa soils are in lower positions, and Francitas soils are in similar positions.

Typical pedon of Narta fine sandy loam; from Texas Highway 6 in Santa Fe, about 4 miles south on Farm Road 646 to Farm Road 2004, 2.5 miles south on shell road, 1.9 miles east and southeast, 0.8 mile southeast on road on levee, and 300 feet east, in a pasture:

A—0 to 9 inches; dark gray (10YR 4/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; hard, friable, nonsticky and nonplastic; many fine roots; common fine discontinuous pores; few wormcasts; saline; mildly alkaline; clear smooth boundary.

Btg1—9 to 14 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium columnar structure; very hard, very firm, sticky and plastic; common fine roots; few white salt crystals on ped surfaces; few fine black concretions; few strong brown root stains; saline; moderately alkaline; clear smooth boundary.

Btg2—14 to 38 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few very dark gray streaks from the Btg1 horizon; few medium brown concretions; few salt crystals on ped surfaces; saline; moderately alkaline; gradual smooth boundary.

Bkg—38 to 60 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; many fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very hard, very firm, very sticky and very plastic; few fine roots; few medium pitted concretions of calcium carbonate; few fine black concretions; saline; moderately alkaline.

The thickness of the solum ranges from 30 to more than 60 inches. Reaction ranges from neutral to moderately alkaline in the A horizon and is mildly alkaline or moderately alkaline in the B horizon. Soil salinity ranges from 2 to 16 millimhos per centimeter in the A horizon, and from 8 to 30 millimhos per centimeter in the B horizon.

The A horizon is dark gray, gray, dark grayish brown, grayish brown, or light brownish gray.

The Btg horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, or light brownish gray. Mottles in shades of brown and yellow range from none to common. Texture is silty clay, clay, clay loam, or silty clay loam. The content of clay in the upper 20 inches of the Btg horizon averages about 35 to 45 percent. Exchangeable sodium ranges from 15 to about 45 percent. Concretions of calcium carbonate range from none to common.

The Bkg horizon is gray, light gray, white, or light brownish gray. Mottles in shades of brown and yellow range from none to common. Texture is clay loam or clay.

Nass Series

The Nass series consists of nearly level, very poorly drained, saline, loamy soils in coastal marsh areas. The surface is concave. The slopes range from 0 to 1 percent.

Other associated soils are Galveston, Karankawa, Mustang, and Sabine soils. Galveston, Mustang, and Sabine soils are in higher positions on the landscape than Nass soils. Karankawa soils are in slightly lower positions.

Typical pedon of Nass very fine sandy loam; from Texas Spur 342 in Galveston, about 9 miles southwest on Farm Road 3005 to Stewart Road, 0.1 mile southwest on Farm Road 3005, 0.4 mile northwest and southwest on paved road, 0.4 mile north, 0.2 mile southwest, and 30 feet south of road, in rangeland:

A—0 to 27 inches; dark gray (10YR 4/1), very fine sandy loam, light gray (10YR 6/1) dry; common medium distinct light gray (10YR 7/2) mottles; single grained, loose; many fine roots; common strong brown stains; few sand-size shell fragments; slightly saline; mildly alkaline; clear wavy boundary.

Cg1—27 to 44 inches; gray (N 5/0) loamy very fine sand, light gray (N 7/0) dry; common coarse prominent dark brown (10YR 3/3) mottles; single grained, loose; few fine roots; common strong brown stains; few sand-size shell fragments; moderately saline; moderately alkaline; clear wavy boundary.

Cg2—44 to 57 inches; dark grayish brown (10YR 4/2) very fine sand, light brownish gray (10YR 6/2) dry; common medium distinct light gray (10YR 7/2) mottles; single grained, loose; common strong brown stains; few sand-size shell fragments; strongly saline; moderately alkaline; clear wavy boundary.

Cg3—57 to 65 inches; gray (N 5/0) very fine sand, light gray (N 7/0) dry; common medium distinct dark brown (10YR 4/3) mottles; single grained, loose; common strong brown and black organic stains; common sand-size shell fragments; strongly saline; moderately alkaline.

Reaction ranges from neutral to moderately alkaline. The soil moisture is seldom at the wilting point. A permanent high water table ranges from a depth of 6 inches below the surface to 24 inches above the soil surface. The electrical conductivity varies seasonally and with rainfall but is generally between 2 and 16 millimhos per centimeter in the upper 20 inches of these soils and is between 4 and 25 millimhos per centimeter below a depth of 20 inches. The sodium adsorption ratio (SAR) is less than 15. Texture is loamy fine sand, very fine sand, loamy very fine sand, or very fine sandy loam. The control section contains at least one horizon that is loamy very fine sand or very fine sand, or a finer sand. Few to many gray, brown, and yellow mottles are in most pedons. In most pedons, these soils contain sand-size shell fragments.

The A horizon is dark gray, gray, very dark grayish brown, dark grayish brown, or light grayish brown. The thickness of the A horizon ranges from 4 to 35 inches. If the value is 3, the thickness of the A horizon is less than 7 inches.

The Cg horizon is very dark gray, dark gray, gray, light gray, very dark grayish brown, light brownish gray, or grayish brown. Some pedons have a Cg horizon that has loamy strata at a depth of more than 40 inches, and some have a Cg horizon that has thin strata that contain up to 30 percent marine shells.

The Nass soils in map unit Nx is a taxadjunct to the Nass series because they have shell fragments in the substratum and have a black surface layer. However, this does not affect the use, behavior, and management of these soils.

Placedo Series

The Placedo series consists of nearly level, very poorly drained, saline, clayey soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 0.5 percent.

Other associated soils are Caplen, Follet, Harris, Tracosa, and Veston soils. Caplen, Follet, and Tracosa soils are in slightly lower positions on the landscape than Placedo soils; Harris soils are in similar positions; and Veston soils are in slightly higher positions.

Typical pedon of Placedo clay; from Texas Farm Road 124 about 1 mile southeast of High Island, 2.9 miles southwest on U.S. Highway 87, 1.2 miles north on field road, and 100 feet west of road, in rangeland:

Ag1—0 to 6 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; moderate medium subangular blocky structure; very hard, very firm, sticky and very plastic; many fine roots and pores; few brown organic stains; estimated 10 percent fibric material; strongly saline; moderately alkaline; clear smooth boundary.

Ag2—6 to 28 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; moderate medium subangular blocky structure; very hard, very firm, sticky and very plastic; common fine roots; few fine brown concretions; strongly saline; moderately alkaline; gradual smooth boundary.

Cg1—28 to 36 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; massive; very hard, very friable, sticky and very plastic; few fine roots; few thin light gray sandy loam strata; strongly saline; moderately alkaline; gradual smooth boundary.

Cg2—36 to 60 inches; light gray (N 6/0) sandy clay, light gray (N 7/0) dry; massive; very hard, very firm, sticky and very plastic; few medium brown concretions; strongly saline; moderately alkaline.

Clayey and loamy alluvium is more than 60 inches thick. The clay content in the 10- to 40-inch control section ranges from 35 to 50 percent. Reaction is mildly alkaline or moderately alkaline throughout. These soils range from calcareous to noncalcareous. Salinity as expressed in millimhos per centimeters ranges from 16 to 40 in the control section.

The Ag1 horizon is dark gray or gray. It is 4 to 18 inches thick.

The Ag2 horizon is dark gray, gray, or light gray. In some pedons, the Ag2 horizon has fine and medium yellowish and brownish mottles. Texture is clay, silty clay, or silty clay loam.

The Cg horizon has the same color range as the A horizon. Texture ranges from loam to clay. This horizon has strata of fine sandy loam or sandy loam in some part.

Sabine Series

The Sabine series consists of nearly level, somewhat excessively drained, nonsaline, sandy soils in coastal areas. The surface is slightly convex. The slopes range from 0 to 1 percent.

Other associated soils are Mustang, Nass, and Veston soils. Mustang and Veston soils are in slightly lower positions on the landscape than Sabine soils. Nass soils are in the low, depressional areas.

Typical pedon of Sabine loamy fine sand; from Loop 108 east of Port Bolivar, 3.3 miles northeast on Texas Highway 87, and 30 feet north, in a pasture:

A—0 to 14 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; many fine pores; few brown organic streaks; slightly acid; clear smooth boundary.

C—14 to 30 inches; brown (10YR 5/3) fine sand, pale brown (10YR 6/3) dry; few medium distinct yellowish brown (10YR 5/6) mottles; single grained; loose, nonsticky and nonplastic; few fine roots; few very dark gray organic streaks; common very dark grayish brown loamy sand pockets from the A horizon; slightly acid; gradual smooth boundary.

Cg1—30 to 60 inches; light brownish gray (10YR 6/2) loamy fine sand, light gray (10YR 7/2) dry; few medium faint gray (10YR 5/1) and grayish brown (10YR 5/2) mottles; single grained; loose, nonsticky and nonplastic; few fine roots; few brown organic streaks and common reddish yellow organic streaks; few pockets of pale brown sand; neutral; gradual smooth boundary.

Cg2—60 to 75 inches; light gray (10YR 7/2) fine sand, white (10YR 8/2) dry; few fine distinct gray (10YR 5/1) and brown (10YR 5/3) mottles; single grained; loose, nonsticky and nonplastic; common reddish yellow organic streaks; few brown stains; few dark gray sand pockets; moderately alkaline.

Depth to loamy or clayey strata is more than 80 inches. Texture is fine sand or loamy fine sand throughout. The content of silt and clay is more than 10 percent. Few and common marine shell fragments are in some pedons at a depth of more than 30 inches. Reaction ranges from medium acid to moderately alkaline. The soil surface may become slightly saline for brief periods in some years during extended dry periods because of salt spray.

The A horizon is black, very dark gray, very dark brown, very dark grayish brown, or dark brown. It is 10 to 22 inches thick.

The C horizon is grayish brown, light brownish gray, brown, pale brown, or very pale brown. It is 10 to 40 inches thick.

The Cg horizon is gray, light gray, grayish brown, or light brownish gray.

Sievers Series

The Sievers series consists of nearly level to gently sloping, somewhat poorly drained, saline, loamy soils in coastal marsh areas. These soils formed in materials dredged from rivers, bays, canals, and bayous. The surface is plane to convex. The slopes range from 0 to 3 percent.

Other associated soils are Follet, Placedo, Tracosa, and Veston soils. These soils are in lower positions on the landscape than Sievers soils. Unlike Sievers soils, these soils did not form in dredged materials.

Typical pedon of Sievers loam, 0 to 3 percent slopes; from Texas Highway 124 in High Island, about 10 miles southwest on Texas Highway 87, about 1.5 miles northwest of Caplen to Sun Oil Company Canal, 0.2 mile east along the Intracoastal Waterway, and 30 feet north of waterway, in a marsh:

A—0 to 12 inches; grayish brown (10YR 5/2) loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine roots; 5 percent sand-size shell fragments; moderately saline; moderately alkaline; clear smooth boundary.

C1—12 to 15 inches; dark grayish brown (10YR 4/2) stratified loam, grayish brown (10YR 5/2) dry; weak bedding planes; hard, firm, slightly sticky and slightly plastic, few fine roots; few brown organic stains; few fine shell fragments; moderately saline; moderately alkaline; clear smooth boundary.

C2—15 to 24 inches; mottled dark grayish brown (10YR 4/2), light gray (10YR 6/1) and brown (10YR 5/3) stratified clay loam; common medium faint yellowish brown (10YR 5/4) mottles; weak bedding planes; hard, very firm, sticky and plastic; few fine roots; few brown organic stains; moderately saline; moderately alkaline.

Cg1—24 to 30 inches; gray (10YR 5/1) stratified loam, light gray (10YR 6/1) dry; common fine faint light gray and dark gray mottles, common fine distinct yellowish brown (10YR 5/6) mottles; weak bedding planes; hard, firm, slightly sticky and slightly plastic; few fine roots; few thin loamy fine sand strata; few brown organic stains; moderately saline; moderately alkaline.

Cg2—30 to 45 inches; light gray (10YR 6/1) loam, light gray (10YR 7/1) dry; common fine faint light brownish gray mottles, common fine distinct yellowish brown (10YR 5/4) and brown (10YR 5/3) mottles; weak bedding planes; slightly hard, firm, slightly sticky and slightly plastic; few fine roots; 5 percent sand-size shell fragments; moderately saline; moderately alkaline.

Cg3—45 to 60 inches; mottled light brownish gray (10YR 6/2) and dark grayish brown (10YR 4/2) stratified loam and fine sandy loam; weak bedding planes; hard, firm, slightly sticky and slightly plastic; few fine shell fragments; moderately saline; neutral.

Bedding planes are weak to strong, and these soils are weakly to strongly stratified. Texture, in the upper 40 inches of these soils is dominated by loam, fine sandy loam, clay loam, sandy clay loam, silt loam, or silty clay loam. Some pedons have thin sandy or clayey strata in the control section. Thicker sandy or clayey strata are common at a depth of more than 40 inches. Oyster shell fragments range from none to many throughout, and some thin strata are about 70 percent oyster shell fragments. Reaction ranges from slightly acid to moderately alkaline throughout. The salinity typically ranges from about 2 to 12 millimhos per centimeter, but recently deposited materials can range up to 25 millimhos per centimeter for a few years following deposition.

The A and C horizons are dark gray, gray, light gray, dark grayish brown, grayish brown, or light brownish gray. Mottles in shades of gray, brown, or yellow range from none to common.

The Cg horizon has the same colors as the A and C horizons, and, in addition, may have strata of brown, yellowish brown, and pale brown. Mottles in shades of gray, brown, yellow, or red range from none to many.

Stowell Series

The Stowell series consists of nearly level to gently sloping, somewhat poorly drained, nonsaline, sandy soils in upland areas. The surface is slightly convex. The slopes range from 0 to 2 percent.

Other associated soils are Edna, Follet, Leton, and Narta soils. Edna soils are in slightly lower positions on the landscape than Stowell soils. Follet and Narta soils are in lower positions. Follet and Narta soils are in the coastal marsh. Leton soils are in depressional areas.

Typical pedon of Stowell loamy fine sand, in an area of Stowell-Leton complex, 0 to 2 percent slopes; from Texas Highway 146 in the northwestern part of Texas City, 3.8 miles east on Loop 197, 0.2 mile north on paved road, and 650 feet west, in a pasture:

A—0 to 16 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine pores; few brown organic stains; strongly acid; clear smooth boundary.

E—16 to 26 inches; light gray (10YR 7/2) loamy fine sand, white (10YR 8/2) dry; single grained; loose, nonsticky and nonplastic; few fine roots; few brown organic stains; strongly acid; clear smooth boundary.

Btg1—26 to 50 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; slightly hard, firm, slightly sticky and plastic; few fine roots; common fine and medium reddish brown concretions; medium acid; clear smooth boundary.

Btg2—50 to 58 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; common fine distinct dark reddish brown (2.5YR 3/4), yellowish brown (10YR 5/6), and grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine dark concretions; medium acid; gradual smooth boundary.

Btg3—58 to 62 inches; light gray (10YR 7/2) sandy clay loam; white (10YR 8/2) dry; common fine distinct grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; common uncoated sand grains; medium acid.

The thickness of the solum ranges from 50 to more than 80 inches.

The A and E horizons are loamy fine sand. The combined thickness of these horizon ranges from about 40 to 60 inches. Reaction ranges from strongly acid to slightly acid. Some parts of the E horizon are saturated for 3 to 5 months during rainy periods.

The A horizon is very dark gray or very dark grayish brown.

The E horizon is dark grayish brown, grayish brown, light brownish gray, light gray, pale brown, or very pale brown. Few to common brownish yellow and yellowish brown mottles are in the E horizon of some pedons. The boundary between the E and Bt horizons is abrupt or clear and smooth or wavy.

The upper part of the Bt horizon is dark yellowish brown, yellowish brown, or brownish yellow. It has few or common gray and strong brown mottles, or it is dominated by grayish colors and has common or many brownish mottles. The lower part is dark grayish brown, grayish brown, light brownish gray, gray, or light gray. It has common or many fine and medium yellowish and brownish mottles. Texture of the Bt horizon ranges from fine sandy loam to sandy clay loam.

Tatlum Series

The Tatlum series consists of nearly level, very poorly drained, saline, loamy soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 0.5 percent.

Other associated soils are Caplen, Follet, Placedo, Tracosa, and Veston soils. Caplen, Placedo, and Veston soils are in slightly higher positions on the landscape than Tatlum soils. Follet and Tracosa soils are in similar positions.

Typical pedon of Tatlum mucky clay loam; from Port Bolivar, about 9 miles northeast by boat in East Bay, 0.8 mile south in Big Elmgrove Bayou, and 100 feet south, in a marsh:

Ag—0 to 12 inches; gray (10YR 5/1) mucky clay loam, light gray (10YR 6/1) dry; massive; flows easily between fingers, leaves little residue in hand when squeezed; slightly sticky and slightly plastic; many fine roots; few brown organic stains; estimated 45 percent hemic material; strongly saline; mildly alkaline; clear smooth boundary.

Cg1—12 to 38 inches; light gray (10YR 6/1) mucky clay loam, light gray (10YR 7/1) dry; few fine faint dark yellowish brown mottles; massive; flows easily between fingers, leaves littles residue in hand when squeezed; sticky and slightly plastic; few fine roots; estimated 25 percent hemic material; strongly saline; moderately alkaline; gradual smooth boundary.

Cg2—38 to 60 inches; light gray (10YR 6/1) stratified fine sandy loam, light gray (10YR 7/1) dry; common fine distinct greenish gray (5BG 5/1) mottles; massive; slightly sticky and nonplastic; few fine roots; few loamy strata; few medium brown concretions; strongly saline; moderately alkaline.

These soils have a peraquic moisture regime. All layers at a depth of 8 to 20 inches below the mineral surface have an *n* value of more than 0.7. The *n* value is less than 0.7 between depths of 20 and 40 inches from the mineral surface. Some pedons have an organic mat of decomposing plant material that is 1 to 8 inches thick on the soil surface. Reaction ranges from neutral to moderately alkaline throughout. The electrical conductivity ranges from 25 to 90 millimhos, and the exchangeable sodium is more than 30 percent throughout the control section. The sand fraction is mainly very fine sand throughout the control section. The content of clay in the control section averages 18 to 35 percent.

The Ag horizon is black, very dark gray, dark gray, or gray. Many pedons have an Ag horizon that has few to many mottles in shades of brown and gray. This horizon is 6 to 24 inches thick.

The Cg horizon is dark gray, gray, light gray, dark grayish brown, or light brownish gray. If chroma of 2 occurs, the Cg horizon always contains mottles. The hue commonly changes on exposure to air. Texture ranges from very fine sandy loam to clay, or their mucky analogs. The horizon is generally stratified. Mottles in shades of gray and brown range from few to many. In some pedons, the Cg horizon has brown clayey layers at a depth of more than 40 inches. These layers are commonly calcareous.

Tracosa Series

The Tracosa series consists of nearly level, very poorly drained, saline, clayey soils in coastal marsh areas. The surface is plane. The slopes range from 0 to 0.5 percent.

Other associated soils are Follet, Francitas, Narta, Placedo, and Veston soils. Follet soils are in slightly lower positions on the landscape than Tracosa soils. The other associated soils are in higher positions.

Typical pedon of Tracosa mucky clay; about 6 miles south of Hitchcock, from the intersection of Greens Lake and the Intracoastal Waterway, 0.8 mile northwest in Greens Lake by boat to shoreline, and 25 feet west, in a marsh:

A—0 to 12 inches; dark gray (10YR 4/1) mucky clay, gray (10YR 5/1) dry; few fine distinct brown (10YR 5/3) mottles; massive; sticky and plastic; many fine and medium roots; common strong brown organic stains; estimate 10 percent fibric material; *n* value is more than 0.7; strongly saline; mildly alkaline; clear smooth boundary.

Cg1—12 to 18 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common medium distinct brown (10YR 5/3) mottles; massive; sticky and plastic; few fine roots; few brown organic stains; few streaks of black sapric material; strongly saline; moderately alkaline; gradual smooth boundary.

Cg2—18 to 45 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common medium distinct brown (10YR 5/3) mottles; massive; very sticky and plastic; few fine roots; few fine brown concretions; strongly saline; moderately alkaline; gradual smooth boundary.

Cg3—45 to 60 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; few fine distinct dark greenish gray (5BG 4/1) mottles; massive; very sticky and plastic; few fine brown concretions; strongly saline; moderately alkaline.

These soils have a peraquic moisture regime. The surface layer in some pedons has *n* value of more than 0.7 but is less than 20 inches thick. In some pedons, these soils have a peaty or mucky surface layer that is 2 to 8 inches thick. Reaction ranges from neutral to moderately alkaline throughout. The electrical conductivity ranges from 20 to 90 millimhos, and the exchangeable sodium is more than 20 percent throughout the control section.

The A horizon is black, very dark gray, dark gray, gray, very dark brown, very dark grayish brown, dark grayish brown, or grayish brown. It is 3 to 18 inches thick. If the values are 2 to 3, the thickness of the A horizon is less than 6 inches. Texture is mucky clay or clay.

The Cg horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, or light brownish gray. Texture is clay loam, silty clay loam, silty clay, or clay. The content of clay ranges from 35 to 60 percent. Mottles in shades of gray, brown, and greenish gray ranges from none to many. Some pedons have a Cg horizon that has a loamy horizon at a depth of more than 40 inches; and in some pedons, the Cg horizon has a brown calcareous layer at a depth of more than 40 inches.

Vamont Series

The Vamont series consists of nearly level, somewhat poorly drained, nonsaline, clayey soils in upland areas. The surface is plane. The slopes range from 0 to 1 percent.

Other associated soils are Bacliff, Edna, and Lake Charles soils. Bacliff soils are in similar positions on the landscape as Vamont soils. Edna and Lake Charles soils are in slightly higher positions.

Typical pedon of Vamont clay; from Texas Farm Road 517 in Dickinson, 0.6 mile northwest on frontage road of U.S. Interstate 45, 0.2 mile east, 0.2 mile north to northwest, 500 feet east, and 300 feet north, in a wooded area:

A—0 to 6 inches; dark grayish brown (10YR 4/2) clay, grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/6) and olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; very hard, very firm, very sticky and plastic; common fine and medium roots; common fine pores; few wormcasts; medium acid; abrupt wavy boundary.

Bw1—6 to 38 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; many fine distinct yellowish brown (10YR 5/6) and olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine and medium roots; few fine pores; few wormcasts; few shiny pressure faces; few intersecting slickensides; medium acid; gradual wavy boundary.

Bw2—38 to 43 inches; light brownish gray (10YR 6/2) clay, light gray (10YR 7/2) dry; many fine prominent yellowish brown (10YR 5/6) and common fine distinct olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine and medium roots; few medium brown concretions; few slickensides; medium acid; gradual wavy boundary.

Bg—43 to 62 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; common fine distinct yellowish brown (10YR 5/6) and brown (7.5YR 5/4) mottles; weak coarse blocky structure; very hard, very firm, very sticky and plastic; few coarse roots; few medium brown concretions; neutral.

The thickness of the solum ranges from 70 to more than 100 inches. Undisturbed areas have gilgai microrelief of microknolls that are 6 to 15 inches higher than the microdepressions. The 10- to 40-inch control section is 45 to 60 percent clay and more than 30 percent silt. Intersecting slickensides and wedge-shaped parallelepipeds begin at a depth of 8 to 25 inches.

The A horizon is very dark gray, very dark grayish brown, dark grayish brown, or brown. It is strongly acid to neutral.

The Bw horizon is yellowish brown, brownish yellow, light olive brown, grayish brown or light brownish gray. Mottles in shades of gray, brown, yellow, or red are few or common. It is strongly acid to neutral.

The Bg horizon is light gray, gray, or grayish brown. Mottles in shades of yellow, red, or brown are few or common. Reaction is medium acid to mildly alkaline. In some pedons, this horizon is calcareous. In some pedons, calcium carbonate concretions, up to 2 inches in diameter, are visible in the C horizon. Black concretions range from none to many throughout.

Verland Series

The Verland series consists of nearly level, somewhat poorly drained, nonsaline, loamy soils in upland areas. The surface is plane. The slopes range from 0 to 1 percent.

Other associated soils are Aris, Bacliff, Bernard, Edna, Kemah, and Lake Charles soils. Aris, Edna and Kemah soils are in higher positions on the landscape than Verland soils. Bacliff and Lake Charles soils are in lower positions. Bernard soils are in similar positions.

Typical pedon of Verland silty clay loam; from U.S. Interstate 45 in Dickinson, 1.0 mile west on Texas Farm Road 517, 750 feet south on Farm Road 646, and 50 feet east, in a pasture:

A—0 to 6 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine roots; common fine pores; few wormcasts; few strong brown organic stains; slightly acid; clear smooth boundary.

Btg1—6 to 30 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles, few fine distinct brown (10YR 5/3) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few pressure faces; few dark

concretions 2 to 5 millimeters across; few brown organic stains; thin clay film on faces of peds; medium acid; gradual smooth boundary.

Btg2—30 to 52 inches; light gray (10YR 6/1) clay, light gray (10YR 7/1) dry; few fine distinct dark gray (10YR 4/1) mottles, common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few pressure faces; few pitted concretions of calcium carbonate 5 to 10 millimeters across; thin clay films on faces of peds; mildly alkaline; gradual wavy boundary.

Btg3—52 to 60 inches; light gray (5Y 6/1) clay, light gray (5Y 7/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine blocky structure; very hard, very firm, very sticky and plastic; few fine roots; few dark concretions 10 to 20 millimeters across; patches of clay films on faces of peds; moderately alkaline.

The thickness of the solum is more than 50 inches. Coefficient of linear extensibility (COLE) values are more than 0.09 throughout the B horizon.

The A horizon is dark gray, gray, dark grayish brown, or grayish brown. It is 4 to 16 inches thick. Reaction ranges from medium acid to mildly alkaline.

Some pedons have a BA horizon that is less than 10 inches thick. It is dark gray, gray, dark grayish brown, grayish brown, or light brownish gray. Mottles in shades of yellow, brown, or gray range from none to common. Reaction ranges from medium acid to mildly alkaline.

The B horizon is dark gray, gray, light gray, dark grayish brown, light brownish gray, olive gray, or light olive gray. Texture is clay, clay loam, silty clay, sandy clay, or silty clay loam. The content of clay in the upper 20 inches of the B horizon is 40 to 60 percent. Mottles in shades of yellow, brown, or gray range from few to many. Typically, a layer that has few pitted concretions of calcium carbonate is in the lower part of this horizon. Reaction ranges from medium acid to moderately alkaline.

Some pedons have a C horizon that is gray, light gray, grayish brown, or light brownish gray. Texture is clay, clay loam, silty clay, sandy clay loam, sandy clay, or silty clay loam. Mottles in shades of yellow, brown, or red range from none to common. This horizon may contain few pitted concretions of calcium carbonate. Reaction ranges from slightly acid to moderately alkaline.

Veston Series

The Veston series consists of nearly level, poorly drained, saline, loamy soils in coastal marsh areas. The surface is plane to slightly convex. The slopes range from 0 to 1 percent.

Other associated soils are Follet, Galveston, Mustang, Placedo, and Sabine soils. Follet soils are in lower positions on the landscape than Veston soils. Galveston, Mustang, and Sabine soils are in higher positions. Placedo soils are in similar positions and also are in slightly lower positions on the landscape than Veston soils.

A typical pedon of Veston loam, in an area of Veston loam, slightly saline-strongly saline complex; from Texas Highway 146 in Texas City, 3 miles east on Spur 197, 0.8 mile east on paved road, 0.9 mile north to curve, 0.1 mile east to levee, 0.8 mile north on levee to curve, 500 feet south of levee, and 300 feet west, in a pasture:

A—0 to 10 inches; dark gray (10YR 4/1) loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; hard, friable, slightly sticky and plastic; many fine and medium roots; common brown organic root stains; common thin sandy loam strata less than 2 inches thick; strongly saline; moderately alkaline; abrupt wavy boundary.

Cg1—10 to 28 inches; gray (10YR 5/1) loam, light gray (10YR 6/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; massive; hard, firm, slightly sticky and plastic; common fine roots; few brown organic root stains; few thin discontinuous grayish brown sandy loam strata; strongly saline; moderately alkaline; clear wavy boundary.

Cg2—28 to 60 inches; light gray (10YR 6/1) clay loam, light gray (10YR 7/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; massive; very hard, firm, very sticky and plastic; few fine roots; few fine pores; few thin sand strata; few fine brown concretions; strongly saline; moderately alkaline; gradual wavy boundary.

2Cg—60 to 65 inches; bluish gray (5B 6/1) clay, light bluish gray (5B 7/1) dry; many fine distinct yellowish brown (10YR 5/6) and common fine distinct gray (10YR 5/1) mottles; massive; very hard, very firm, very sticky and plastic; few medium pitted concretions of calcium carbonate; strongly saline; moderately alkaline.

The thickness of the solum ranges from 30 to more than 60 inches. In most years, these soils are saturated with water during the cool season. Salinity is moderately or strongly affected.

The A horizon is very dark gray, dark gray, gray, very dark grayish brown, grayish brown, or light brownish gray. Mottles in shades of yellow, gray, and brown range from none to common. This horizon is 8 to 14 inches thick. If moist values are less than 3.5, the horizon is less than 7 inches thick. Texture of the A horizon is variable. It is stratified fine sandy loam, loam, silt loam, clay loam, or silty clay loam. The A horizon ranges from neutral to moderately alkaline.

The Cg horizon is dark gray, gray, light gray, dark grayish brown, grayish brown, or light brownish gray. Texture of the 10- to 40-inch control section is loam, silt loam, silty clay loam, or clay loam. The content of clay in

the control section ranges from about 18 to 30 percent, content of sand coarser than very fine sand is less than 15 percent, and content of silt is more than 20 percent. In some pedons, the Cg horizon has thin strata of coarser or finer textures. The Cg horizon is moderately alkaline or strongly alkaline.

In pedons that have a 2Cg horizon, colors are similar to those in the Cg horizon, and, in addition, this horizon has colors of bluish gray or light bluish gray.

Formation of the Soils

This section discusses the factors of soil formation, explains the processes of soil formation, and relates them to the formation of the soils in the survey area.

Factors of Soil Formation

The characteristics of the soil at any given point are determined by five factors. These factors include the physical and mineral composition of the parent material; the climate since the parent material was deposited; the plant and animal life on and in the soil; the relief, or topography, of the land; and the length of time since the parent material was deposited. These five factors influence the characteristics of every soil. However, the influence of each factor varies from place to place. For example, in Galveston County the parent material has a dominant influence on the soil, whereas in other counties it may not be as important as other factors.

The interrelationship of these five factors is complex, and the effect of any one factor cannot be isolated and completely evaluated. However, it is convenient to discuss each factor separately and to indicate its effects on the soil.

Parent Material

Parent material is the unconsolidated mass from which a soil is formed. Although parent material can be deposited in many ways, the parent material in Galveston County was laid down mainly by water from flood plain related sediment or shallow water marine sediment. Some parent material was reworked by wind after initial deposition.

Several kinds of flood plain sediments were deposited during the Pleistocene geologic age. One type of flood plain sedimentation was in the broad areas of slightly lower flood basins associated with large rivers. These sediments were clayey throughout and covered large backwater areas away from the ancient river. This is now the area of soils such as Bacliff and Lake Charles.

The second type of flood plain sedimentation was associated with distributary channels of these large rivers. Distributary channels, remnants of which can still be readily observed today, are associated with the delta of a large river that had a low gradient and a large sediment load. The distributary channels are the streams in this delta. The main sediments in these areas in Galveston County are loamy in nature. The sediments immediately adjacent to the channel formed a high bank or natural levee where the sediments were fairly thick. The loamy sediments became thinner and thinner as the distance from the channel increased. Because of the nature of distributary channels, they often changed course. When this happened, the old channel was left as a remnant on the landscape while the new course of the distributary channel probably flowed through and developed again in an area of clayey flood basin sediments.

In these distributary channel areas, loamy sediment was more or less laid on top of the existing clayey sediment. One exception is in the channel itself where much of the original sediment was washed away and the channel was later partly filled with loamy material. Today, soils, such as Aris and Kemah soils, represent areas where natural levees were located, while soils, such as Edna soils, were further away from the channel in which only a thin layer of loamy sediment was deposited. The Leton soils are often in areas where the actual channel was located. Soils, such as the Bernard and Verland soils, are generally associated with transition areas between the distributary channel system and the clayey flood basin. A notable exception in this system, which is not well understood today, is the large areas of loamy soils, such as the Algoa and Mocarey soils. These areas of loamy soils were most probably associated with large distributary channel systems that are now relict meander ridges.

The water-laid deposits are those associated with shallow water marine sediment of the Holocene geologic age and are still changing today. The most obvious areas are Galveston Island and Bolivar Peninsula, which are barrier islands that formed during this time. Over time, these areas have grown larger by sandy beach deposits that were deposited in front of the existing shoreline. They have all been reworked to some degree by wind action. Most of these deposits were sandy with only occasional small amounts of shell fragments. Generally, the large dune areas correspond with areas of soils such as Galveston and Sabine soils. The slightly lower areas that have less active dune formation generally correspond to soils such as the Mustang soils. The depressional areas generally correspond to soils such as the Nass soils.

The shallow water marine sediments are those associated with recently filled bays and present-day

bays. The sediments are varied since they result from the mixing of sediment washed into the bays from the adjacent land and sediment carried in by water in the bay. Soils that formed from this type of parent material are Caplen, Karankawa, Placedo, and Tracosa soils.

Although water was responsible for much of the sedimentation in the county, wind has, in some cases, modified or altered the sediments after initial deposition. The most noticeable example is on Bolivar Peninsula and Galveston Island where wind is constantly reworking the sand dunes along the Gulf of Mexico. All of the sandy deposits in these two areas have been reworked by the wind. The Galveston, Sabine and Mustang soils are examples. It is generally thought that the loamy sediments associated with the distributary channels were also reworked to some degree by wind. The Aris and Algoa soils are good examples.

Parent material also affects soil formation because it is the material that the other soil-forming factors alter.

Climate

The climate affects soil formation since rainfall and warm temperatures are needed for the soil forming processes to function. The climate in Galveston county is humid, or warm and moist. Therefore, the climate is good for soil development. Abundant moisture is available to move clay particles, weathering products, and weathering agents into and through the soil; however, this does not necessarily happen because other soil forming factors may not allow much movement of water through the soil.

The temperature is favorable for soil development because warm temperature is the factor that promotes chemical activity in and on the soil particles and in the water solution in the soil.

Climate is also favorable for abundant plant growth which also promotes soil development.

Plant and Animal Life

Plant and animal life includes such things as grasses, trees, micro-organisms in the soil, and animals that live in or use the soil, such as earthworms, crawfish, and some insects. Plants use nutrients in the soil for growth, which can influence soil development. Plant roots also grow into the soil. When these roots die, they leave cavities where water and air can move through and loosen up the soil which enhances soil development.

Plants also add to the organic matter content of the soil when they die and decompose, which influences soils development. In Galveston County, plant growth has been abundant on nearly all soils, and is expressed in the present soil characteristics. For example, on soils such as Bernard, Lake Charles, and Mocarey soils, organic matter is largely responsible for the dark color of the soil surface. On the Caplen soil, a large amount of partly decomposed organic matter accumulated on the original soil surface. On this soil, organic matter was added faster than it could be decomposed and therefore accumulated on the soil surface until it finally reached an equilibrium in recent time. The organic matter in many of the soils is the reason they are naturally fertile.

Animals also influence soil development. Animals, such as earthworms, crawfish, and other burrowing animals, tend to mix the soil, open cavities as a result of burrowing, and eat material that is in the soil. The main effect is that air and water can move through the soil easier and soil particles are moved around in the upper part of the soil. Within recent years, the activity of man has also become an important factor in soil formation. A prime example is the "grade raising" of Galveston in the early 1900's when, as discussed in the history section, an average of about 5 feet of sand was pumped on top of the original soil throughout most of the city.

Relief

Relief primarily affects the movement of water on and in the soil. Most of the relief in the county is nearly level; thus, soil erosion is not an important factor affecting soil formation as in many other counties. Relief affects soil drainage, however, which is important in the county. Since water remains on the soil longer than usual in these nearly level areas, more water enters and moves in the soil. The affect in the county has been expressed mainly by the gray, or gleyed, soil layers in the soil that resulted from the excess water that remained on the soil for extended periods. Some soils, such as Bacliff soils, and marsh soils, such as Follet, Karankawa, Placedo, and Nass soils, are gleyed almost throughout, while other soils, such as Aris, Mustang, and Verland soils, have gleyed layers at a lower depth.

Some parts of the county have depressional areas that receive water from the surrounding soils and tend to pond water. In these areas, soil formation can be accelerated. Leton and Nass soils are good examples. In the Leton soil, the large amount of excess water that moved through the soil has already resulted in the movement of many clay-size particles down into lower layers in the soil. In the Nass soil, this has not happened since the parent material contained essentially no clay-size particles to move.

Time

The length of time that the soil forming factors have acted on the parent material determines, to a large degree, the soil characteristics if the soils are in a favorable position on the landscape and have favorable materials for soil development. With the exception of soils such as Galveston, Mustang, and Nass soils, the soils in the county have favorable landscape positions and materials for soil development.

Processes of Horizon Differentiation

In the above sections, most of the soils were indicated to have favorable parent material, climate, plant and animal activity, and relief for favorable soil development. However, the sediments are comparatively young in age and not enough time has elapsed for many of the more advanced stages of soil development to be expressed strongly. In some cases, the soil has probably already reached its equilibrium with all of the soil forming factors. Examples include Caplen soils and probably Galveston soils.

Expressions of soil formation that can be attributed to soil development in Galveston County included dark soil surfaces, accumulation of calcium carbonate in lower layers, movement of clay-size particles to lower layers in the soil, and the reduction of iron and/or manganese.

Under the conditions in the county, the development of dark surface layers is probably a fairly rapid process. The soils that did not develop them generally did not consistently produce enough organic matter from the decay of plant material to allow the color to develop. Bernard, Lake Charles, and Mocarey soils are examples of soils that did develop the dark surface layers while Aris, Edna, and Kemah soils are examples of soils that did not develop them.

The accumulation of calcium carbonate in the lower layers of the soil is an example of material that is moved in the soil very easily and in some instances can accumulate at some point in the soil. Calcium carbonate is relatively soluble in water in soil systems and is moved around by it. The Algoa, Cieno, and Mocarey soils are good examples where large accumulations have occurred. In other cases, calcium carbonate will move all the way through the soil. This probably occurred in the Leton soils that are associated with the Algoa and Mocarey soils.

Clay-size particles are mainly moved by water over time to deeper layers in the soil. This process is generally fairly slow, but it can begin as soon as the parent material is laid down unless some material like calcium carbonate is in the parent material. In most cases, materials, such as calcium carbonate, have to be leached or moved down before any significant amount of clay particles can be moved. The Leton soil is a good example of a soil where a significant amount of clay has moved or translocated to lower layers in the soil. Some soils, such as Galveston and Sabine soils, do not have enough clay-size particles in the parent material to show this type of soil development. Most of the other soils in the county have enough clay and other conditions that will allow clay to be moved, but the soils are too young for this to be expressed.

The reduction of iron and manganese in the soil can also occur rapidly under the right conditions, such as a high water table that remains in the soil for long periods during the year. The high water table makes the soil anaerobic, which causes a chemical reaction with iron and manganese, that, if present, causes it to change to a gray color. If a significant amount of these elements is in the soil, the entire soil layer will turn gray. However, in some places in the county, the parent material was already gray so the existence of a gray layer in the soil does not mean that iron and/or manganese has been reduced in the soil.

Surface Geology

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Galveston County is in the West Gulf subdivision of the Altantic and Gulf Coastal Plains geomorphic unit of the United States *(14)* in which the sediments and sedimentary rocks dip gently seaward. The sediments of Galveston County, at the seaward edge of the Coastal Plain, are among the youngest and range in age from Pleistocene to Holocene. The county can be divided by age into two distinct geomorphic units. The mainland, which is in the northwestern part of the county, is largely Pleistocene in age and mainly of alluvial or delta plain origin. The southern and eastern parts of the county, which is a barrier island and a peninsula respectively, are Holocene in age, less than 3,500 years old, and mainly of marine coastal and eolian origin. Saline soils, influenced by the present level of the sea, are in both geomorphic units. The surfaces of these geomorphic units, to some degree, display a relict depositional topography that can be related to the underlying sediment and to the soils surfacing them.

The general soil map can serve as an approximation for the soil-parent material relationship: the Mustang-Galveston, Ijam, and Placedo-Tracosa-Veston map units are Holocene in age, and the remainder of the map units are Pleistocene. The geology of the county is depicted on the small-scale 1:250,000 Houston Sheet of the Geologic Atlas of Texas *(28)* where the Pleistocene upland is shown to be underlain by the Beaumont Formation and the offshore Holocene part by alluvium and barrier island deposits. The environmental geology map of the Environmental Geologic Atlas of the Texas Coastal Zone—Galveston-Houston area *(11)* shows a variety of environments of depositions for the county's sediments.

Beaumont Formation

The surface features of the Beaumont Formation of Galveston County can be classified as relict meander ridges and deltaic distributaries with associated flood basin and interdistributary "lows,"; a small segment of a relict barrier or strandplain; and a salt-dome elevated Pleistocene surface surrounded by Holocene sediments.

The paleo-Brazos River is responsible for most of the surface deposits and relict depositional topography of

the county. These were laid down by a laterally shifting Brazos River during the late Pleistocene age when sea level may have been similar to the present. The overall fluvial and deltaic pattern can be seen on several published maps *(29, 11)*. These old meander ridges and the present-day Brazos River emerge in a fanlike pattern from the older Lissie Formation outcrop area *(27, 28)* near Richmond in Fort Bend County and can be identified in the soil surveys of Fort Bend *(21)*, Harris *(25)*, and Brazoria Counties *(26)*.

The well-drained deposits of the present-day Brazos River have characteristic reddish brown, brown, and brownish yellow colors derived from the oxidized Permian "red beds" through which the Brazos River flows in northwest Texas. These colors can be seen in many deep pits and excavations in Galveston County below a depth of about 10 feet. A few of the local soils, such as Algoa, Kemah, and Mocarey soils, have brownish yellow and yellowish brown colors, continuous or as prominent mottles, in the lowest parts of their profiles. These are probably the upper fringes of the underlying colors mentioned above.

In the northern part of the county, north of the latitude of Texas City, the relict meander ridges have an easterly trend and in the southern part of the county they have a southeasterly trend. The arcuate shoreline of Galveston Bay, between Kemah and San Leon, parallels one of the meander ridges. In the higher areas of the county, the meander ridges are topped by soils of the Mocarey-Leton-Algoa map unit, and to a lesser extent, by soils of the Bernard-Edna and Kemah-Edna-Leton map units. Within these map units, the soils with loamy substrates, such as Cieno, Kemah, Leton, Mocarey, and Morey soils, have probably developed on fluvial point bar, levee, and crevasse splay deposits. Some of the meander ridges still retain the relict outlines of meandering stream channels. Leton, Lake Charles, and Bernard soils mainly are on these ridges. Some of these ridges can be seen on Map Sheets 7, 8, 12, and 18 in the back of this soil survey.

Along the northwest shore of West Bay above the level of the coastal marshes, the meander ridge patterns merge in a northeast trending pattern that may represent an overlapping of the small deltas terminating each ridge. The Narta-Francitas map unit is the poorly drained margin of the Pleistocene-age sediments.

Pleistocene fluvial and deltaic sands are exposed in many sand pits in the county. Soil profiles are described to a depth of about 6 feet, and they are not deep enough to characterize the fluvial and deltaic sands that are below the soils described. Textures and sedimentary structures observed in a sand pit near Algoa have been described in a recent study *(12)*.

The intermeander ridge, flood basin, and delta interdistributary topographic swales are typically the sites of the Bernard-Verland and Lake Charles-Bacliff map units. The Vertisols, such as Bacliff, Lake Charles and Vamont soils, were probably formed in fine-grained flood basin and interdistributary deposits. The soils with mainly clayey substrates, such as Algoa, Aris, Bernard, Edna, and Verland soils have clayey substrates that extend through to similar deposits. Their loamy surfaces can be the result of Pleistocene-age crevasse splays or breakthroughs of floodwaters from meander ridges, or they can be the result of subsequent wind and sheet flow transport from the higher, more loamy areas.

Some of the surfaces of the Vertisols exhibit gilgai microrelief *(13)*, particularly in areas which have not been cultivated recently. The gilgaied surfaces exhibit shallow depressions that are less than 20 feet in diameter and are separated by low ridges. Local relief is mainly less than 1.5 feet. The microrelief is initiated by the volume loss and cracking of the surface clays during prolonged dry periods. The subsequent filling of the cracks by soil infall and by rehydration causes uneven expansion of the clays in an upward direction. On airphotos, the gilgai frequently appears as a fine-grained, mottled or "wormy" pattern. Examples can be seen on Map Sheets 19, 20 and 24 in the back of this soil survey in some of the delineations of the Bacliff soils.

The fragmentation, lack of continuity, merging of meander ridges and their attendant soils, and the varying degrees of preservation of individual meandering channels are probably the result of the successive abandonment or avulsions of large segments of meander ridges. The avulsions occurred during major floods when the paleo-Brazos River overflowed its channel and flowed into the lower adjacent flood basins, thus abandoning its previous downstream course. The discarded lower reaches were then partly buried by flood basin sediment from younger meander belts. The relict fluvial topography was subjected to wind and sheet flow erosion and deposition. The slow mass-wasting or colluviation processes also accompany soil profile development.

The lithologic discontinuities at the top of the C horizon or within the C horizon as noted in the soil profile descriptions of Algoa *(17)*, Kemah, and Mocarey soils can result from sediment accumulation during the initial formation of the depositional topography or from its subsequent modification.

Modern analogies to the deposition of the Beaumont sediments include the combined Holocene-age alluvial plains of the Brazos and Colorado Rivers and the alluvial plain, or "delta", of the Rio Grande River. These rivers were not confined to narrow upland alluvial valleys but shifted laterally while they prograded over broad estuarine and shallow shelf surfaces.

Two minor microrelief features have contributed to the "obliteration" of the fluvial patterns: small undrained depressions and pimple mounds.

Some elongated, undrained depressions are clearly a part of stream channels. The partial fillings of these channels by wind deposition or mass-wasting processes

created the depressions. Other depressions that are more circular in pattern may represent a later stage in the filling process. Many depressions, however, are probably deflationary depressions that were caused by wind erosion during periods of drier climates. Many of these depressions in adjacent Harris County, which was mapped topographically with a contour interval of 1 foot earlier in this century, displayed raised rims less than 2 feet in height. These have since been eliminated by soil tillage and land leveling. Cieno and Leton soils are typically in the undrained depressions in Galveston County.

Pimple mounds are circular to elongated microknolls that are 15 to 200 feet across and generally are less than 3 feet in height. In Galveston County, parts of Algoa, Aris, Edna, Mocarey, and Morey soils are in the mound areas. Most of the relief of the mounds can be attributed to an increase in the thickness of the A horizon and of the E horizon, if present in the pedon.

Leton soils in the Leton-Lake Charles complex have an undulating, moundlike, ridged microtopography. Similarly, the Stowell soils in the Stowell-Leton complex have an undulating, ridged surface but have more relief. Leton and Stowell soils have probably developed on a stable, much degraded, dune topography.

Theories for the origin of pimple mounds are numerous (*(7)*). Pimple mounds may originate through different processes in different areas.

Pimple mounds are confined to areas west of the Mississippi River. In the Gulf Coast region, they range from about the latitude of Corpus Christi into East Texas up to Arkansas and extend as far north as Minnesota. They occur in Louisiana west of the Holocene-age flood plain of the Mississippi River. In Colorado, California, Washington, and Oregon, they are known as "mima mounds."

Theories of origin include their formation as residual patches left after either sheetflood erosion or deflation of the surface by the wind; accumulations of wind-transported sand, silt, or clay pellets or chips around clumps of vegetation—similar to the coppice mounds of more arid regions; wind accumulation sites which were started by or later enhanced by erosional processes; and the "fluffing up" or decreasing the bulk densities of solum material by burrowing animals or the lateral and centripetal transport of surface materials by animals, both with possible eolian increments—known as the "gopher hypothesis." It is believed that eolian activity is the major factor in the origin of mounds, at least in Texas and Louisiana. The lithologic discontinuities in the soil profiles of Algoa and Mocarey soils can reflect lateral eolian transport and deposition of the upper horizons in these soils.

One of the pedogenic effects of the pimple mound microrelief can be the high calcium carbonate content in some of the mounded soils, especially Algoa and Mocarey soils that have a calcium carbonate-rich Bk horizon. The presence of a Bk horizon in an area of high rainfall like the upper Gulf Coast of Texas is anomalous. A recent study *(17)* of the mounded areas of Algoa soils and intermounded areas of Leton soils in Galveston County suggests a possible mechanism for the accumulation and persistence of the Bk horizon. Calcium carbonate solution occurs in the poorly drained Leton soils in the intermounded areas. High evaporation in the better drained mound areas and the resultant lateral movement by capillarity of the calcium carbonate-rich soil water toward the higher Algoa soil mounds results in calcium carbonate precipitate.

The small delineation of the Stowell-Leton complex, unique in Galveston County, in the Bernard-Verland map unit northeast of Texas City and south of Dollar Bay (see Map Sheet 14) is an isolated segment of the Ingleside barrier or strandplain system *(16, 31)*. This Pleistocene-age littoral deposit was first identified near Corpus Christi and extends intermittently into southwestern Louisiana. The local occurrence is collinear with those in Chambers County to the northeast *(24)* where the sandiest soils are also mapped as Stowell soil and with those in Brazoria County to the southwest *(26)* where the littoral deposit constitutes Rattlesnake Mound and a low ridge east of Hoskins Mound. On Rattlesnake Mound, the soils are Galveston fine sand; near Hoskins Mound, the Leton-Aris complex.

The Ingleside Formation in Galveston County records a minor episode of shoreline stability during the deposition of the Beaumont Formation. Later, it was surrounded by and partly buried by Beaumont-age paleo-Brazos sediments. None of the original ridged surface remains. It was removed by eolian activity.

Mainly in the Holocene-age eastern part of the county, a salt-dome uplift has preserved a small delineation of the Pleistocene age Kemah-Edna-Leton soils around High Island. The caprock of the High Island salt dome is about 150 feet below the surface and is the top of a spire of salt that originated more than 30,000 feet below the surface. High Island is surrounded by Holocene-age sediments, which accumulated after the rise of the dome. The soils, by analogy from the mainland area of the county, have formed on fluvial or deltaic sediment whose adjacent parts were submerged by regional tilting.

The beach area seaward of High island is often stripped of Holocene-age sand by storms, thus exposing Beaumont-age sediments that are similar to those on High Island. The Beaumont Formation that eroded here and in the offshore area is the source of the many calcium carbonate nodules that litter the beach.

The Beaumont Formation and other older coastal Pleistocene stratigraphic units were deposited during the interglacial stages when the continental glaciers retreated and sea level rose *(5)*. The age of the Beaumont Formation is in dispute. Many radiocarbon samples indicate dates of more than 40,000 years, suggesting the Sangamon interglacial stage between the

Illinoian and Wisconsin stage, centering around 125,000 years ago *(32)*. Other samples have ranged in age from about 25,000 to 30,000 years before the present, perhaps indicating a mid-Wisconsin sea-level rise *(12)*.

In any case, some time after the deposition of the Beaumont Formation, the sea level dropped between 260 and 450 feet below present day sea level as glaciers were reconstituted and water abstracted from the oceans. The time of the maximum low was probably about 18,000 years ago. Streams draining into the Gulf of Mexico and elsewhere incised their flood plains and flowed toward a lower, distant ocean. The Brazos River by this time occupied a more westerly channel, but the incised Trinity River flowed in a channel approximately through Trinity Bay and Galveston Bay and then through Bolivar Roads between Galveston Island and Bolivar Peninsula *(8)*.

Sea level rose gradually after the 18,000 years "low" and stabilized at the present level between 2,500 and 4,000 years ago.

Holocene Barrier Islands and Alluvium

The soils that developed in Holocene-age materials are mostly in the Mustang-Galveston and Placedo-Tracosa-Veston map units. The poorly drained, clayey Placedo-Tracosa-Veston map unit borders East Bay and West Bay and a small part of Galveston Bay near Texas City. The sandy Mustang-Galveston map unit fronts on the Gulf of Mexico on Galveston Island and Bolivar Peninsula.

Both Galveston Island and Bolivar Peninsula began to form before sea level rose to its present stage. Galveston Island started about 5,000 years ago as a small offshore bar on the southwest side of what is now Galveston Bay in less than 10 feet of water. Upon its emergence above sea level, it accreted in a southwesterly direction. Bolivar Peninsula began extending about 3,000 years ago by the process of spit accretion by the rise in the Pleistocene-age surface that is associated with High Island *(6, 8)*. The Bolivar Peninsula and the High Island surface rise display an accretionary or regressive beach ridge pattern as they enlarged seaward. Growth occurred in the direction of the dominant southwesterly longshore drift of sand. The ridge pattern is the combined result of two processes: the inland eolian transport of sand producing a foredune upwind from the beach and the deposition of storm berms by exceptional storms just seaward of the foredune.

On Bolivar Peninsula, soils near the shore, such as Galveston, Mustang, Nass, and Sabine soils, are mostly sands. Loamy soils, such as Follet and Veston soils, are farther inland. Near the shore, the waves efficiently sort the sand; further sorting is accomplished by eolian transport. The lagoonside of the peninsula is the area of hurricane overwash deposits. The two arcuate bulges into East Bay are inactive washover fans that are surfaced with clayey soils, such as Tracosa soil, and loamy soils, such as Tatlum, Follet and Caplen soils. The channels feeding the fans have been sealed off by littoral drift. A major hurricane in the future may add to these fans or establish new fans.

The overall pattern of soils on Galveston Island is similar to that of the sandy soils on Bolivar Peninsula on the seaward side of Galveston Island and loamy and clayey soils on the lagoonside. The "feathery" and "frayed" appearance of the island on the lagoonside is because of the many northwest-trending "tidal guts" and some crossing beach ridges. These inlets persist because of heavy run-off, tidal action, and rare (since 1900) storm washovers. They probably originated as washover channels and as swales between northwest trending beach ridges as the termination of the island accreted and migrated southwestward toward San Luis Pass. Parallel to some of the tidal guts are elongated and festoonlike delineations of a complex of Mustang soils that are partly wind-blown (most recently) and superimposed on older washover surfaces. Loamy materials are probably added to the low lagoonside of the island by very high tides and by higher storm surge waters entering West Bay through Bolivar Roads and San Luis Pass.

The northwest shore of West Bay is bordered by part of the Placedo-Tracosa-Veston map unit. This area of saline soils has formed from sediment that was derived from storm erosion of the adjacent low uplands.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. Soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels, i.e., clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). The volume of soft soil decreases excessively under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious

layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, such as fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay are in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium is in the soil. The resulting poor physical properties restrict the growth of plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The movement of water into the soil is rapid.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant that is not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An

explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the plants that are the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Pitting (in tables). Pits are caused by melting ground ice. They form on the soil after plant cover is removed.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size

of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). In these areas, surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of the acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Rippable bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). There is a shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables.) Water is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). The soil mass is susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). An excessive amount of toxic substances in the soil, such as sodium or sulfur, severely hinders the establishment of vegetation or severely restricts plant growth.

Trace elements. Chemical elements, such as zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). There is a risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of course grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. This contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data recorded in the period 1951-78 at Galveston, Texas]

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	^{o}F	^{o}F	^{o}F	^{o}F	^{o}F	Units	In	In	In		In
January----	59.3	48.0	53.7	73	25	198	2.80	1.14	4.19	6	.1
February---	61.1	50.4	55.8	75	29	202	2.37	.81	3.65	5	.1
March------	66.4	56.5	61.5	79	36	363	1.99	.34	3.25	3	.0
April------	73.3	65.0	69.2	84	48	576	2.61	.85	4.05	4	.0
May--------	79.8	71.7	75.8	87	58	800	3.14	.59	5.12	4	.0
June-------	85.1	77.2	81.2	92	67	936	3.68	1.13	5.75	4	.0
July-------	87.3	79.1	83.2	94	70	1,029	3.27	.78	5.26	5	.0
August-----	87.5	78.8	83.2	94	70	1,029	4.48	1.46	6.95	6	.0
September--	84.6	75.4	80.0	92	63	900	5.66	1.78	8.82	6	.0
October----	77.7	67.8	72.8	87	50	707	2.68	.81	4.20	4	.0
November---	68.6	57.9	63.3	81	37	405	3.34	1.12	5.16	5	.0
December---	62.5	51.3	56.9	76	30	234	3.71	1.88	5.29	6	.0
Yearly:											
Average--	74.4	64.9	69.7	---	---	---	---	---	---	---	---
Extreme--	---	---	---	95	24	---	---	---	---	---	---
Total----	---	---	---	---	---	7,379	39.73	31.01	47.94	58	.2

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 ^{o}F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data recorded in the period 1951-78 at Galveston, Texas]

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	January 14	February 7	February 23
2 years in 10 later than--	December 27	January 28	February 13
5 years in 10 later than--	*	December 23	January 25
First freezing temperature in fall:			
1 year in 10 earlier than--	January 8	January 2	December 10
2 years in 10 earlier than--	January 24	January 13	December 18
5 years in 10 earlier than--	*	February 17	January 3

* Probability of occurence of threshold temperature is less than indicated probability.

TABLE 3.--GROWING SEASON

[Data recorded in the period 1951-78 at Galveston, Texas]

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	365	356	308
8 years in 10	365	365	317
5 years in 10	365	365	336
2 years in 10	365	365	365
1 year in 10	365	365	365

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AaB	Arents, clayey, 0 to 3 percent slopes	760	0.2
Ar	Aris fine sandy loam	760	0.2
Ba	Bacliff clay	6,200	1.5
Bb	Beaches	1,900	0.4
Be	Bernard clay loam	22,950	5.4
Bn	Bernard-Edna complex	6,100	1.4
Bu	Bernard-Urban land complex	520	0.1
Ca	Caplen mucky silty clay loam	1,080	0.3
Ct	Caplen-Tracosa complex	1,000	0.2
Ed	Edna fine sandy loam	6,500	1.5
Es	Edna-Aris complex	940	0.2
Fo	Follet loam	4,100	1.0
Fr	Francitas clay	1,800	0.4
GaB	Galveston fine sand, undulating	880	0.2
Gc	Galveston-Nass complex	2,500	0.6
Gd	Galveston-Urban land complex	6,600	1.6
Gs	Galveston loamy fine sand, shell substratum	640	0.2
Ha	Harris clay	490	0.1
ImA	Ijam clay, 0 to 2 percent slopes	7,900	1.9
ImB	Ijam clay, 2 to 8 percent slopes	720	0.2
Iu	Ijam-Urban land complex	3,100	0.7
Ka	Karankawa mucky loam	4,400	1.0
KeA	Kemah silt loam, 0 to 1 percent slopes	6,600	1.6
KeB	Kemah silt loam, 1 to 3 percent slopes	1,000	0.2
Ku	Kemah-Urban land complex	5,500	1.3
LaA	Lake Charles clay, 0 to 1 percent slopes	29,030	6.8
LaB	Lake Charles clay, 1 to 5 percent slopes	1,500	0.4
Lb	Lake Charles-Urban land complex	560	0.1
Le	Leton loam	2,900	0.7
Ls	Leton-Aris complex	7,300	1.7
Lx	Leton-Lake Charles complex	520	0.1
Ma	Mocarey loam	4,600	1.1
Mb	Mocarey-Algoa complex	10,900	2.6
Mc	Mocarey-Cieno complex	4,400	1.0
Md	Mocarey-Leton complex	15,600	3.7
Me	Morey silt loam	2,700	0.6
Mf	Morey-Leton complex	3,900	0.9
Mn	Mustang fine sand	9,900	2.3
Mp	Mustang fine sand, saline	1,900	0.4
Ms	Mustang fine sand, slightly saline-strongly saline complex	2,600	0.6
Mt	Mustang-Nass complex	5,800	1.4
Mu	Mustang-Urban land complex	750	0.2
Na	Narta fine sandy loam	11,280	2.6
Ns	Nass very fine sandy loam	330	0.1
Nx	Nass-Galveston complex, shell substratum	260	0.1
Pa	Pits, sand	241	0.1
Pd	Placedo clay	10,200	2.4
Sa	Sabine loamy fine sand	1,750	0.4
SeB	Sievers loam, 0 to 3 percent slopes	3,300	0.8
StA	Stowell-Leton complex, 0 to 2 percent slopes	540	0.1
Ta	Tatlum mucky clay loam	560	0.1
Tc	Tracosa clay, low	3,300	0.8
Tm	Tracosa mucky clay	1,250	0.3
Tx	Tracosa mucky clay-clay, low complex	4,150	1.0
Va	Vamont clay	2,300	0.5
Ve	Verland silty clay loam	10,100	2.4
Vn	Veston loam, moderately saline	1,200	0.3
Vs	Veston loam, strongly saline	1,200	0.3
Vx	Veston loam, slightly saline-strongly saline complex	3,600	0.8
	Water	169,600	39.9
	Total	424,961	100.0

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
Ar	Aris fine sandy loam
Ba	Bacliff clay [where drained]
Be	Bernard clay loam
Bn	Bernard-Edna complex
LaA	Lake Charles clay, 0 to 1 percent slopes
LaB	Lake Charles clay, 1 to 5 percent slopes
Le	Leton loam [where drained]
Ls	Leton-Aris complex [where drained]
Lx	Leton-Lake Charles complex [where drained]
Ma	Mocarey loam
Mb	Mocarey-Algoa complex
Mc	Mocarey-Cieno complex
Md	Mocarey-Leton complex
Me	Morey silt loam [where drained]
Mf	Morey-Leton complex [where drained]
Va	Vamont clay

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Land capability	Rice	Soybeans	Grain sorghum	Common bermudagrass	Bahiagrass
		Bu	Bu	Bu	AUM*	AUM*
AaB------------- Arents	IIIw	---	---	---	5.0	5.5
Ar-------------- Aris	IIIw	135	30	80	6.0	6.5
Ba-------------- Bacliff	IIIw	140	30	75	6.0	6.0
Bb. Beaches						
Be-------------- Bernard	IIw	145	35	90	6.5	7.0
Bn-------------- Bernard-Edna	IIIw	140	30	80	6.0	6.5
Bu. Bernard-Urban land						
Ca-------------- Caplen	VIIIw	---	---	---	---	---
Ct-------------- Caplen-Tracosa	VIIIw	---	---	---	---	---
Ed-------------- Edna	IIIw	140	25	65	5.5	6.0
Es-------------- Edna-Aris	IIIw	130	27	65	5.8	6.0
Fo-------------- Follet	VIIw	---	---	---	---	---
Fr-------------- Francitas	IVw	---	---	35	---	---
GaB------------- Galveston	VIe	---	---	---	---	---
Gc-------------- Galveston-Nass	VIw	---	---	---	---	---
Gd. Galveston-Urban land						
Gs-------------- Galveston	VIe	---	---	---	4.5	5.0
Ha-------------- Harris	VIIw	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Rice	Soybeans	Grain sorghum	Common bermudagrass	Bahiagrass
		Bu	Bu	Bu	AUM*	AUM*
ImA, ImB-------- Ijam	VIIw	---	---	---	---	---
Iu. Ijam-Urban land						
Ka-------------- Karankawa	VIIw	---	---	---	---	---
KeA------------- Kemah	IIIw	135	30	80	6.0	6.5
KeB------------- Kemah	IIIe	---	25	75	5.0	5.5
Ku. Kemah- Urban land						
LaA------------- Lake Charles	IIw	145	35	90	6.5	7.0
LaB------------- Lake Charles	IIIe	---	25	80	5.5	6.0
Lb. Lake Charles- Urban land						
Le-------------- Leton	IVw	115	25	---	5.0	5.5
Ls-------------- Leton-Aris	IVw	110	27	---	5.5	6.0
Lx-------------- Leton-Lake Charles	IVw	115	27	---	5.5	6.0
Ma-------------- Mocarey	IIIw	130	42	85	6.5	6.0
Mb-------------- Mocarey-Algoa	IIIw	120	41	70	6.3	5.8
Mc-------------- Mocarey-Cieno	IVw	120	---	70	6.0	5.5
Md-------------- Mocarey-Leton	IVw	105	35	60	6.0	5.5
Me-------------- Morey	IIIw	130	37	80	6.5	6.0
Mf-------------- Morey-Leton	IVw	110	30	60	6.0	5.5
Mn, Mp, Ms------ Mustang	VIw	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Rice	Soybeans	Grain sorghum	Common bermudagrass	Bahiagrass
		Bu	Bu	Bu	AUM*	AUM*
Mt-------------- Mustang-Nass	VIw	---	---	---	---	---
Mu. Mustang-Urban land						
Na-------------- Narta	VIs	---	---	---	---	---
Ns-------------- Nass	VIIw	---	---	---	---	---
Nx-------------- Nass-Galveston	VIw	---	---	---	---	---
Pa. Pits						
Pd-------------- Placedo	VIIw	---	---	---	---	---
Sa-------------- Sabine	IIIs	---	---	---	4.5	5.0
SeB------------- Sievers	VIw	---	---	---	---	---
StA------------- Stowell-Leton	IVw	---	---	---	4.5	5.0
Ta-------------- Tatlum	VIIIw	---	---	---	---	---
Tc, Tm, Tx------ Tracosa	VIIw	---	---	---	---	---
Va-------------- Vamont	IIIw	140	30	75	6.5	7.0
Ve-------------- Verland	IIIw	140	30	75	6.0	6.5
Vn-------------- Veston	VIw	---	---	---	---	---
Vs, Vx---------- Veston	VIIs	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit [one cow, one horse, one mule, five sheep, or five goats] for 30 days.

TABLE 7.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
AaB Arents	Blackland	9,000	7,000	6,000
Ar Aris	Loamy Prairie	8,500	6,500	5,000
Ba Bacliff	Blackland	9,000	7,000	6,000
Be Bernard	Blackland	9,000	7,500	7,000
Bn:				
Bernard	Blackland	9,000	7,500	7,000
Edna	Claypan Prairie	8,000	6,000	5,000
Ca Caplen	Deep Marsh	16,000	13,000	10,000
Ct:				
Caplen	Deep Marsh	16,000	13,000	10,000
Tracosa	Tidal Flat	18,000	17,000	15,000
Ed Edna	Claypan Prairie	8,000	6,000	5,000
Es:				
Edna	Claypan Prairie	8,000	6,000	5,000
Aris	Loamy Prairie	8,500	6,500	5,000
Fo Follet	Tidal Flat	16,000	14,000	12,000
Fr Francitas	Salty Prairie	9,000	7,000	5,000
GaB Galveston	Low Coastal Sand	5,000	4,000	3,000
Gc:				
Galveston	Low Coastal Sand	5,000	4,000	3,000
Nass	Coastal Swale	4,500	3,200	1,500
Gs Galveston	Coastal Sand	5,500	4,500	3,500
Ha Harris	Salt Marsh	14,000	11,000	8,000
ImA, ImB Ijam	Salty Prairie	8,000	6,500	5,500
Ka Karankawa	Tidal Flat	14,000	12,000	10,000

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
KeA, KeB------------------ Kemah	Loamy Prairie-------------------------	7,500	7,000	6,500
LaA, LaB------------------ Lake Charles	Blackland-----------------------------	9,500	8,000	6,500
Le------------------------ Leton	Lowland-------------------------------	6,000	5,000	4,000
Ls:				
Leton-------------------	Lowland-------------------------------	6,000	5,000	4,000
Aris--------------------	Loamy Prairie-------------------------	8,500	6,500	5,000
Lx:				
Leton-------------------	Lowland-------------------------------	6,500	5,500	4,500
Lake Charles------------	Blackland-----------------------------	9,000	7,500	6,000
Ma------------------------ Mocarey	Loamy Prairie-------------------------	9,000	7,500	6,000
Mb:				
Mocarey-----------------	Loamy Prairie-------------------------	9,000	7,500	6,000
Algoa-------------------	Loamy Prairie-------------------------	8,500	7,000	5,500
Mc:				
Mocarey-----------------	Loamy Prairie-------------------------	9,000	7,500	6,000
Cieno-------------------	Lowland-------------------------------	8,000	6,000	5,000
Md:				
Mocarey-----------------	Loamy Prairie-------------------------	9,000	7,500	6,000
Leton-------------------	Lowland-------------------------------	6,000	5,000	4,000
Me------------------------ Morey	Loamy Prairie-------------------------	8,500	6,500	5,500
Mf:				
Morey-------------------	Loamy Prairie-------------------------	8,500	6,000	5,000
Leton-------------------	Lowland-------------------------------	6,000	5,000	4,000
Mn------------------------ Mustang	Low Coastal Sand----------------------	4,000	3,000	2,000
Mp------------------------ Mustang	Coastal Swale-------------------------	2,600	1,750	900
Ms:				
Mustang, slightly saline	Low Coastal Sand----------------------	4,000	3,000	2,000
Mustang, strongly saline	Salt Flat-----------------------------	200	150	100
Mt:				
Mustang-----------------	Low Coastal Sand----------------------	4,000	3,000	2,000

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Mt:				
Nass	Coastal Swale	4,500	3,200	1,500
Na Narta	Salty Prairie	7,000	5,300	2,000
Ns Nass	Coastal Swale	4,500	3,200	1,500
Nx:				
Nass	Coastal Swale	4,500	3,200	1,500
Galveston	Low Coastal Sand	5,000	4,000	3,000
Pd Placedo	Salt Marsh	12,000	10,000	8,000
Sa Sabine	Coastal Sand	6,500	6,000	5,000
SeB Sievers	Salty Prairie	8,000	7,000	6,000
StA:				
Stowell	Loamy Prairie	7,000	6,000	4,000
Leton	Lowland	6,000	5,000	4,000
Ta Tatlum	Tidal Flat	13,000	11,000	8,000
Tm Tracosa	Tidal Flat	18,000	17,000	15,000
Tx Tracosa	Tidal Flat	13,000	11,000	8,000
Va Vamont	Blackland	9,000	7,000	5,500
Ve Verland	Blackland	8,500	6,500	5,500
Vn Veston	Salty Prairie	8,500	6,500	5,000
Vs Veston	Salt Marsh	10,000	8,000	7,000
Vx:				
Veston, strongly saline	Salt Marsh	10,000	8,500	7,000
Veston, slightly saline	Salty Prairie	8,500	6,500	5,000

TABLE 8.--SELECTED PLANTS FOR LANDSCAPING

[Only the soils suitable for growing shrubs and trees are listed]

Map symbol and soil name	Shrubs	Small trees	Trees
Ar, Es*, Ls*: Aris	Althea, American beautyberry, banana, blackhaw viburnum, bridalwreath, elderberry, flowering quince, Nandina, possumhaw, sumac, osmanthus, trifoliate orange, waxmyrtle, yaupon.	American holly, Carolina cherry-laurel, crapemyrtle, farkleberry, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, river birch, sassafras, satsuma orange, silverbell.	Baldcypress, basswood, blackgum, bur oak, Chinese elm, Chinese pistache, dawn redwood, loblolly pine, magnolia, Nuttall oak, red maple, sweetgum, water oak, white oak.
Ba: Bacliff	Elderberry, juniper, Nandina, photina, pittosporum, possumhaw, primrose, jasmine, pyracantha, sumac, turk's cap, yaupon.	Carolina cherry-laurel, Chinese pistache, crapemyrtle, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, Texas persimmon, yew.	American elm, baldcypress, basswood, camphor-tree, cedar elm, cherrybark oak, green ash, live oak, loblolly pine, Nuttall oak, pecan, red maple, Shumard oak, sweetgum, water oak.
Be, Bn*, Bu*: Bernard	Elderberry, juniper, Nandina, photina, pittosporum, possumhaw, primrose, jasmine, pyracantha, sumac, turk's cap, yaupon.	Carolina cherry-laurel, Chinese pistache, crapemyrtle, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, Texas persimmon, yew.	American elm, baldcypress, basswood, camphor-tree, cedar elm, cherrybark oak, green ash, live oak, loblolly pine, Nuttall oak, pecan, red maple, Shumard oak, sweetgum, water oak.
Bn*, Ed, Es*: Edna	Althea, American beautyberry, banana, blackhaw viburnum, bridalwreath, elderberry, flowering quince, Nandina, possumhaw, sumac, osmanthus, trifoliate orange, waxmyrtle, yaupon.	American holly, Carolina cherry-laurel, crapemyrtle, farkleberry, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, river birch, sassafras, satsuma orange, silverbell.	Baldcypress, basswood, blackgum, bur oak, Chinese elm, Chinese pistache, dawn redwood, loblolly pine, magnolia, Nuttall oak, red maple, sweetgum, water oak, white oak.
Fr: Francitas	Evergreen euonymus, lantana, ligustrum, oleander, Pfitzer juniper, pittosporum, shore juniper, thorny elaeagnus, waxmyrtle, yaupon.	Gum bumelia, huisache, Japanese black pine, Mediterranean palm, tamarisk.	Australian pine, cabbage palm, camphor-tree, Chinese tallowtree, eastern redcedar, mesquite, parkinsonia, Washington palm.
GaB, Gc*, Gd*, Gs, Nx*: Galveston	Barbados cherry, bottlebrush, cleyera, dwarf bamboo, oleander, plumbago, pomegranate, rosemary, sage palm, shore juniper, osmanthus, thorny elaeagnus, waxmyrtle, yaupon.	Chastetree, common fig, European fanpalm, Florida anise-tree, Japanese black pine, Japanese crapemyrtle, loquat, Mediterranean palm, pindo palm, sassafras, Texas ebony, windmill palm.	Baldcypress, Chinese elm, Deodar cedar, eastern redcedar, live oak, parkinsonia, redbay, dollarleaf eucalyptus, spruce pine, sweetgum, Texas palm, Washington palm.
Gc*, Mt*, Ns, Nx*: Nass	Devilwood osmanthus, evergreen euonymus, oleander, pittosporum, shore juniper, thorny elaeagnus, waxmyrtle.	Eastern baccharis, gum bumelia, Japanese black pine, prickly-ash, redbay, tamarisk.	Australian pine, Chinese tallowtree, eastern redcedar, parkinsonia.

See footnote at end of table.

TABLE 8.--SELECTED PLANTS FOR LANDSCAPING--Continued

Map symbol and soil name	Shrubs	Small trees	Trees
KeA, KeB, Ku*: Kemah	Althea, American beautyberry, banana, blackhaw viburnum, bridalwreath, elderberry, flowering quince, Nandina, possumhaw, sumac, osmanthus, trifoliate orange, waxmyrtle, yaupon.	American holly, Carolina cherry-laurel, crapemyrtle, farkleberry, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, river birch, sassafras, satsuma orange, silverbell.	Baldcypress, basswood, blackgum, bur oak, Chinese elm, Chinese pistache, dawn redwood, loblolly pine, magnolia, Nuttall oak, red maple, sweetgum, water oak, white oak.
LaA, LaB, Lb*, Lx*: Lake Charles	Elderberry, juniper, Nandina, photina, pittosporum, possumhaw, primrose, jasmine, pyracantha, sumac, turk's cap, yaupon.	Carolina cherry-laurel, Chinese pistache, crapemyrtle, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, Texas persimmon, yew.	American elm, baldcypress, basswood, camphor-tree, cedar elm, cherrybark oak, green ash, live oak, loblolly pine, Nuttall oak, pecan, red maple, Shumard oak, sweetgum, water oak.
Le, Ls*, Lx*, Md*, Mf*, StA*: Leton	American cyrilla, arrowwood viburnum, buttonbush, ligustrum, Virginia sweetspire, waxmyrtle, yaupon.	Common sweetleaf hawthorn, hazel alder, hophornbeam, hornbeam, river birch, sweetbay.	Baldcypress, black willow, Carolina ash, swamp maple, sweetgum, water hickory, water oak, water tupelo, willow oak.
Ma, Mb*, Mc*, Md*: Mocarey	Agarito, Barbados cherry, elderberry, juniper, Nandina, pittosporum, purple sage, sumac, waxmyrtle, wisteria, yaupon.	Anaqua, autumn olive, crapemyrtle, hawthorn, huisache, Lacey oak, red buckeye, Texas buckeye, Texas persimmon, Texas pistache, Texas redbud, Texas sophora.	American elm, bur oak, cedar elm, Chinese elm, Chinese tallowtree, eastern redcedar, green ash, live oak, pecan, Shumard oak, sugar hackberry, thornless honeylocust, western soapberry.
Mb*: Algoa	Agarito, Barbados cherry, elderberry, juniper, Nandina, pittosporum, purple sage, sumac, waxmyrtle, wisteria, yaupon.	Anaqua, autumn-olive, crapemyrtle, hawthorn, huisache, Lacey oak, red buckeye, Texas buckeye, Texas persimmon, Texas sophora.	American elm, bur oak, cedar elm, Chinese elm, Chinese tallowtree, eastern redcedar, green ash, live oak, pecan, Shumard oak, sugar hackberry, thornless honeylocust, western soapberry.
Mc*: Cieno	Althea, American beautyberry, banana, blackhaw viburnum, bridalwreath, elderberry, flowering quince, Nandina, possumhaw, sumac, osmanthus, trifoliate orange, waxmyrtle, yaupon.	American holly, Carolina cherry-laurel, crapemyrtle, farkleberry, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, river birch, sassafras, satsuma orange, silverbell.	Baldcypress, basswood, blackgum, bur oak, Chinese elm, Chinese pistache, dawn redwood, magnolia, Nuttall oak, red maple, sweetgum, water oak, white oak.
Me, Mf*: Morey	Elderberry, juniper, Nandina, photina, pittosporum, possumhaw, primrose, jasmine, pyracantha, sumac, turk's cap, yaupon.	Carolina cherry-laurel, Chinese pistache, crapemyrtle, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, Texas persimmon, yew.	American elm, baldcypress, basswood, camphor-tree, cedar elm, cherrybark oak, green ash, live oak, loblolly pine, Nuttall oak, pecan, red maple, Shumard oak, sweetgum, water oak.

See footnote at end of table.

TABLE 8.--SELECTED PLANTS FOR LANDSCAPING--Continued

Map symbol and soil name	Shrubs	Small trees	Trees
Mn, Mt*, Mu*: Mustang	Barbados cherry, bottlebrush, cleyera, dwarf bamboo, oleander, plumbago, pomegranate, rosemary, sage palm, shore juniper, osmanthus, thorny elaeagnus, waxmyrtle, yaupon.	Chastetree, common fig, European fanpalm, Florida anise-tree, Japanese black pine, Japanese crapemyrtle, loquat, Mediterranean palm, pindo palm, sassafras, Texas ebony, windmill palm.	Baldcypress, Chinese elm, Deodar cedar, eastern redcedar, live oak, parkinsonia, redbay, dollarleaf eucalyptus, spruce pine, sweetgum, Texas palm, Washington palm.
Mp, Ms: Mustang	Devilwood osmanthus, evergreen euonymus, oleander, pittosporum, shore juniper, thorny elaeagnus, waxmyrtle.	Eastern baccharis, gum bumelia, Japanese black pine, prickly-ash, redbay, tamarisk.	Australian pine, Chinese tallowtree, eastern redcedar, parkinsonia.
Na: Narta	Evergreen euonymus, lantana, ligustrum, oleander, Pfitzer juniper, pittosporum, shore juniper, thorny elaeagnus, waxmyrtle, yaupon.	Gum bumelia, huisache, Japanese black pine, Mediterranean palm, tamarisk.	Aleppo pine, Australian pine, cabbage palm, camphor-tree, Chinese tallowtree, eastern redcedar, mesquite, parkinsonia, Washington palm.
Sa: Sabine	Barbados cherry, bottlebrush, cleyera, dwarf bamboo, oleander, plumbago, pomegranate, rosemary, sage palm, shore juniper, osmanthus, thorny elaeagnus, waxmyrtle, yaupon.	Chastetree, common fig, European fanpalm, Florida anise-tree, Japanese black pine, Japanese crapemyrtle, loquat, Mediterranean palm, pindo palm, sassafras, Texas ebony, windmill palm.	Baldcypress, Chinese elm, Deodar cedar, eastern redcedar, live oak, parkinsonia, redbay, sand pine, dollarleaf eucalyptus, spruce pine, sweetgum, Texas palm, Washington palm.
StA*: Stowell	Barbados cherry, bottlebrush, cleyera, dwarf bamboo, oleander, plumbago, pomegranate, rosemary, sage palm, shore juniper, osmanthus, thorny elaeagnus, waxmyrtle, yaupon.	Chastetree, common fig, European fanpalm, Florida anise-tree, Japanese black pine, Japanese crapemyrtle, loquat, Mediterranean pine, pindo palm sassafras, Texas ebony, windmill palm.	Baldcypress, Chinese elm, Deodar cedar, eastern redcedar, live oak, parkinsonia, redbay, sand pine, dollarleaf eucalyptus, spruce pine, sweetgum, Texas palm, Washington palm.
Va: Vamont	Elderberry, juniper, Naldina, photina, pittosporum, possumhaw, primrose, jasmine, pyracantha, sumac, turk's cap, yaupon.	Carolina cherry-laurel, Chinese pistache, crapemyrtle, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, Texas persimmon, yew.	American elm, baldcypress, basswood, camphor-tree, cedar elm, cherrybark oak, green ash, live oak, loblolly pine, Nuttall oak, pecan, red maple, Shumard oak, sweetgum, water oak.
Ve: Verland	Elderberry, juniper, Nandina, photina, pittosporum, possumhaw, primrose, jasmine, pyracantha, sumac, turk's cap, yaupon.	Carolina cherry-laurel, Chinese pistache, crapemyrtle, golden raintree, hawthorn, jujube, loquat, Mexican plum, redbud, Texas persimmon, yew.	American elm, baldcypress, basswood, camphor-tree, cedar elm, cherrybark oak, green ash, live oak, loblolly pine, Nuttall oak, pecan, red maple, Shumard oak, sweetgum, water oak.

See footnote at end of table.

TABLE 8.--SELECTED PLANTS FOR LANDSCAPING--Continued

Map symbol and soil name	Shrubs	Small trees	Trees
Vn---------------------------- Veston	Evergreen euonymus, lantana, ligustrum, oleander, Pfitzer juniper, pittosporum, shore juniper, thorny elaeagnus, waxmyrtle, yaupon.	Gum bumelia, huisache, Japanese black pine, Mediterranean palm, tamarisk.	Aleppo pine, Australian pine, cabbage palm, camphor-tree, Chinese tallowtree, eastern redcedar, mesquite, parkinsonia, Washington palm.

* These map units contain more than one kind of soil. See description of the map unit for composition and behavior characteristics.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AaB: Arents	Severe: flooding, percs slowly, wetness.	Severe: too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: too clayey.	Severe: wetness, too clayey.
Ar: Aris	Severe: flooding, wetness, shrink-swell.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Ba: Bacliff	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Bb. Beaches					
Be: Bernard	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Bn:					
Bernard	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Edna	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Bu:					
Bernard	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Urban land.					
Ca: Caplen	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey.	Severe: excess salt, ponding, flooding.
Ct:					
Caplen	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey.	Severe: excess salt, ponding, flooding.
Tracosa	Severe: flooding, too clayey, percs slowly.	Severe: flooding, too clayey, excess salt.	Severe: flooding, too clayey, percs slowly.	Severe: flooding, too clayey.	Severe: excess salt, excess sodium, flooding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ed------------------- Edna	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Es:					
Edna-----------------	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Aris-----------------	Severe: flooding, wetness, shrink-swell.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Fo------------------- Follet	Severe: flooding, percs slowly, excess sodium.	Severe: flooding, percs slowly, excess sodium.	Severe: flooding, percs slowly, excess sodium.	Severe: flooding.	Severe: excess salt, excess sodium, flooding.
Fr------------------- Francitas	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
GaB------------------ Galveston	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
Gc:					
Galveston------------	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
Nass-----------------	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.	Severe: ponding, excess salt.
Gd:					
Galveston------------	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
Urban land.					
Gs------------------- Galveston	Severe: flooding.	Moderate: too sandy.	Moderate: flooding, too sandy.	Moderate: too sandy.	Moderate: droughty, flooding.
Ha------------------- Harris	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, excess salt.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: excess salt, wetness.
ImA, ImB------------- Ijam	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, excess salt.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: excess salt, wetness, too clayey.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Iu:					
Ijam	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, excess salt.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: excess salt, wetness, too clayey.
Urban land.					
Ka: Karankawa	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, flooding, excess salt.	Severe: ponding.	Severe: excess salt, ponding, flooding.
KeA, KeB: Kemah	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, erodes easily.	Severe: wetness.
Ku:					
Kemah	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, erodes easily.	Severe: wetness.
Urban land.					
LaA, LaB: Lake Charles	Severe: flooding, percs slowly, wetness.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Lb:					
Lake Charles	Severe: flooding, percs slowly, wetness.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Urban land.					
Le: Leton	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.
Ls:					
Leton	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.
Aris	Severe: flooding, wetness, shrink-swell.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Lx:					
Leton	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Lx:					
Lake Charles---------	Severe: flooding, percs slowly, wetness.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Ma-------------------- Mocarey	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
Mb:					
Mocarey--------------	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
Algoa----------------	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
Mc:					
Mocarey--------------	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
Cieno----------------	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Md:					
Mocarey--------------	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
Leton----------------	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.
Me-------------------- Morey	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Mf:					
Morey----------------	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Leton----------------	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.
Mn-------------------- Mustang	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
Mp-------------------- Mustang	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy, excess salt.	Severe: too sandy, wetness, flooding.	Severe: wetness, too sandy.	Severe: excess salt, wetness, flooding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ms:					
Mustang, slightly saline	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
Mustang, strongly saline	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy, excess salt.	Severe: too sandy, wetness, flooding.	Severe: wetness, too sandy.	Severe: excess salt, wetness, flooding.
Mt:					
Mustang	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
Nass	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.	Severe: ponding, excess salt.
Mu:					
Mustang	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
Urban land.					
Na Narta	Severe: flooding, wetness, percs slowly.	Severe: wetness, excess sodium, excess salt.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness.	Severe: excess salt, excess sodium, wetness.
Ns Nass	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.	Severe: ponding, excess salt.
Nx:					
Nass	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.	Severe: ponding, excess salt.
Galveston	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
Pa. Pits					
Pd Placedo	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, excess salt.	Severe: too clayey, ponding, flooding.	Severe: ponding, too clayey.	Severe: excess salt, ponding, droughty.
Sa Sabine	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: droughty.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
SeB: Sievers	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Slight	Severe: excess salt.
StA:					
Stowell	Severe: flooding.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: wetness.
Leton	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness, erodes easily.	Severe: wetness, flooding.
Ta: Tatlum	Severe: flooding, percs slowly, excess sodium.	Severe: flooding, percs slowly, excess sodium.	Severe: flooding, percs slowly, excess sodium.	Severe: flooding.	Severe: excess salt, excess sodium, flooding.
Tc, Tm, Tx: Tracosa	Severe: flooding, too clayey, percs slowly.	Severe: flooding, too clayey, excess salt.	Severe: flooding, too clayey, percs slowly.	Severe: flooding, too clayey.	Severe: excess salt, excess sodium, flooding.
Va: Vamont	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Ve: Verland	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, erodes easily.	Severe: wetness.
Vn: Veston	Severe: flooding, wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, flooding, excess salt.	Severe: wetness.	Severe: excess salt, wetness, droughty.
Vs: Veston	Severe: flooding, wetness, excess sodium.	Severe: wetness, excess sodium.	Severe: wetness, flooding, excess sodium.	Severe: wetness.	Severe: excess salt, excess sodium, wetness.
Vx:					
Veston, strongly saline	Severe: flooding, wetness, excess sodium.	Severe: wetness, excess sodium.	Severe: wetness, flooding, excess sodium.	Severe: wetness.	Severe: excess salt, excess sodium, wetness.
Veston, slightly saline	Severe: flooding, wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, flooding, excess salt.	Severe: wetness.	Severe: excess salt, wetness, droughty.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
AaB----------------- Arents	Fair	Fair	Fair	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Ar----------------- Aris	Fair	Fair	Good	Fair	Good	Good	Good	Fair	Fair	Good	Good.
Ba----------------- Bacliff	Fair	Fair	Poor	Fair	Fair	Fair	Good	Fair	---	Fair	Fair.
Bb. Beaches											
Be----------------- Bernard	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Bn: Bernard-----------	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Edna--------------	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair.
Bu: Bernard-----------	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Urban land.											
Ca----------------- Caplen	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Good	Very poor.
Ct: Caplen------------	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Good	Very poor.
Tracosa-----------	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Fair	Very poor.
Ed----------------- Edna	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair.
Es: Edna--------------	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair.
Aris--------------	Fair	Fair	Good	Fair	Good	Good	Good	Fair	Fair	Good	Good.
Fo----------------- Follet	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Fair	Very poor.
Fr----------------- Francitas	Poor	Fair	Fair	---	Fair	Poor	Good	Poor	---	Fair	Fair.
GaB---------------- Galveston	Poor	Fair	Fair	---	Fair	Very poor.	Fair	Fair	---	Poor	Fair.
Gc: Galveston---------	Poor	Fair	Fair	---	Fair	Very poor.	Fair	Fair	---	Poor	Fair.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Gc:											
Nass	Very poor.	Very poor.	Very poor.	---	Very poor.	Good	Good	Very poor.	---	Good	Very poor.
Gd:											
Galveston	Poor	Fair	Fair	---	Fair	Very poor.	Fair	Fair	---	Poor	Fair.
Urban land.											
Gs Galveston	Poor	Fair	Fair	---	Fair	Very poor.	Fair	Fair	---	Poor	Fair.
Ha Harris	Very poor.	Very poor.	Poor	---	Very poor.	Good	Good	Very poor.	---	Good	Very poor.
ImA, ImB Ijam	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Iu:											
Ijam	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Urban land.											
Ka Karankawa	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Fair	Very poor.
KeA Kemah	Fair	Good	Good	Fair	Good	Good	Good	Fair	---	Fair	Fair.
KeB Kemah	Fair	Good	Good	Fair	Good	Good	Poor	Fair	---	Poor	Fair.
Ku:											
Kemah	Fair	Good	Good	Fair	Good	Good	Good	Fair	---	Fair	Fair.
Urban land.											
LaA Lake Charles	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
LaB Lake Charles	Fair	Fair	Fair	Good	Fair	Poor	Very poor.	Fair	Good	Poor	Fair.
Lb:											
Lake Charles	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
Urban land.											
Le Leton	Poor	Fair	Fair	---	Fair	Good	Good	Fair	---	Good	Fair.
Ls:											
Leton	Poor	Fair	Fair	---	Fair	Good	Good	Fair	---	Good	Fair.
Aris	Fair	Fair	Good	Fair	Good	Good	Good	Fair	Fair	Good	Good.
Lx:											
Leton	Poor	Fair	Fair	---	Fair	Good	Good	Fair	---	Good	Fair.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Lx:											
Lake Charles------	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
Ma----------------- Mocarey	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
Mb:											
Mocarey-----------	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
Algoa-------------	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
Mc:											
Mocarey-----------	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
Cieno-------------	Poor	Fair	Fair	---	Fair	Good	Good	Fair	Poor	Good	Fair.
Md:											
Mocarey-----------	Fair	Fair	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
Leton-------------	Poor	Fair	Fair	---	Fair	Good	Good	Fair	---	Good	Fair.
Me----------------- Morey	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	Fair.
Mf:											
Morey-------------	Fair	Fair	Fair	Fair	Fair.	Good	Good	Fair	Fair	Good	Fair.
Leton-------------	Poor	Fair	Fair	---	Fair	Good	Good	Fair	---	Good	Fair.
Mn----------------- Mustang	Poor	Poor	Fair	---	Fair	Fair	Good	Poor	---	Fair	Fair.
Mp----------------- Mustang	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair	Fair	Very poor.	---	Fair	Very poor.
Ms:											
Mustang, slightly saline-----------	Poor	Poor	Fair	---	Fair	Fair	Good	Poor	---	Fair	Fair.
Mustang, strongly saline-----------	Poor	Poor	Poor	---	Poor	Fair	Fair	Poor	---	Fair	Poor.
Mt:											
Mustang-----------	Poor	Poor	Fair	---	Fair	Fair	Good	Poor	---	Fair	Fair.
Nass--------------	Very poor.	Very poor.	Very poor.	---	Very poor.	Good	Good	Very poor.	---	Good	Very poor.
Mu:											
Mustang-----------	Poor	Poor	Fair	---	Fair	Fair	Good	Poor	---	Fair	Fair.
Urban land.											
Na----------------- Narta	Poor	Poor	Very poor.	---	Very poor.	Fair	Fair	Poor	---	Fair	Very poor.
Ns----------------- Nass	Very poor.	Very poor.	Very poor.	---	Very poor.	Good	Good	Very poor.	---	Good	Very poor.
Nx:											
Nass--------------	Very poor.	Very poor.	Very poor.	---	Very poor.	Good	Good	Very poor.	---	Good	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Nx:											
Galveston----------	Poor	Fair	Fair	---	Fair	Very poor.	Fair	Fair	---	Poor	Fair.
Pa. Pits											
Pd-----------------Placedo	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Fair	Very poor.
Sa-----------------Sabine	Poor	Fair	Fair	---	Fair	Very poor.	Fair	Fair	---	Poor	Fair.
SeB----------------Sievers	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
StA:											
Stowell-----------	Poor	Fair	Good	Fair	Good	Fair	Fair	Fair	Good	Fair	Good.
Leton-------------	Poor	Fair	Fair	---	Fair	Good	Good	Fair	---	Good	Fair.
Ta-----------------Tatlum	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Fair	Very poor.
Tc, Tm, Tx---------Tracosa	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor	Good	Very poor.	---	Fair	Very poor.
Va-----------------Vamont	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
Ve-----------------Verland	Fair	Good	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
Vn, Vs, Vx---------Veston	Very poor.	Fair	Poor	---	Poor	Good	Good	Poor	---	Good	Poor.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "moderate" and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AaB: Arents	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
Ar: Aris	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Ba: Bacliff	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
Bb. Beaches						
Be: Bernard	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Bn: Bernard	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Edna	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Bu: Bernard	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Urban land.						
Ca: Caplen	Severe: excess humus, ponding, flooding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: excess salt, ponding, flooding.
Ct: Caplen	Severe: excess humus, ponding, flooding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding, flooding.	Severe: excess salt, ponding, flooding.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ct:						
Tracosa	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: excess salt, excess sodium, flooding.
Ed: Edna	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Es:						
Edna	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Aris	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Fo: Follet	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: excess salt, excess sodium, flooding.
Fr: Francitas	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
GaB: Galveston	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Gc:						
Galveston	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Nass	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, excess salt.
Gd:						
Galveston	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Urban land.						
Gs: Galveston	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Ha: Harris	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: excess salt, wetness.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
ImA, ImB: Ijam	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness.	Severe: excess salt, wetness, too clayey.
Iu:						
Ijam	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness.	Severe: excess salt, wetness, too clayey.
Urban land.						
Ka: Karankawa	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: excess salt, ponding, flooding.
KeA, KeB: Kemah	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Ku:						
Kemah	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Urban land.						
LaA, LaB: Lake Charles	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
Lb:						
Lake Charles	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
Urban land.						
Le: Leton	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, low strength, flooding.	Severe: wetness.
Ls:						
Leton	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, low strength.	Severe: wetness.
Aris	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Lx:						
Leton	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, low strength.	Severe: wetness.
Lake Charles	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
Ma: Mocarey	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: low strength, wetness, flooding.	Moderate: wetness.
Mb:						
Mocarey	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: low strength, wetness, flooding.	Moderate: wetness.
Algoa	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength.	Moderate: wetness.
Mc:						
Mocarey	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: low strength, wetness.	Moderate: wetness.
Cieno	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
Md:						
Mocarey	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: low strength, wetness, flooding.	Moderate: wetness.
Leton	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, low strength.	Severe: wetness.
Me: Morey	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness.	Severe: wetness.
Mf:						
Morey	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness.	Severe: wetness.
Leton	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, low strength.	Severe: wetness.
Mn: Mustang	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Mp: Mustang	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: excess salt, wetness, flooding.
Ms:						
Mustang, slightly saline	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness.
Mustang, strongly saline	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: excess salt, wetness, flooding.
Mt:						
Mustang	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness.
Nass	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, excess salt.
Mu:						
Mustang	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness.
Urban land.						
Na: Narta	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: excess salt, excess sodium, wetness.
Ns: Nass	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, excess salt.
Nx:						
Nass	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, excess salt.
Galveston	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Pa. Pits						
Pd: Placedo	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: excess salt, ponding, droughty.
Sa: Sabine	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
SeB--------------- Sievers	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Severe: excess salt.
StA:						
Stowell----------	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: wetness.
Leton------------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, low strength, flooding.	Severe: wetness, flooding.
Ta---------------- Tatlum	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: excess salt, excess sodium, flooding.
Tc, Tm, Tx-------- Tracosa	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: excess salt, excess sodium, flooding.
Va---------------- Vamont	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
Ve---------------- Verland	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
Vn---------------- Veston	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: excess salt, wetness, droughty.
Vs---------------- Veston	Severe: wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: excess salt, excess sodium, wetness.
Vx:						
Veston, strongly saline----------	Severe: wetness, flooding.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: excess salt, excess sodium, wetness.
Veston, slightly saline----------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: excess salt, wetness, droughty.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AaB----------------- Arents	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ar------------------ Aris	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ba------------------ Bacliff	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Bb. Beaches					
Be------------------ Bernard	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Bn: Bernard------------	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Edna---------------	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Bu: Bernard------------	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Urban land.					
Ca------------------ Caplen	Severe: flooding, ponding, percs slowly.	Severe: flooding, excess humus, ponding.	Severe: flooding, ponding, excess humus.	Severe: flooding, ponding, too clayey.	Poor: too clayey, hard to pack, ponding.
Ct: Caplen-------------	Severe: flooding, ponding, percs slowly.	Severe: flooding, excess humus, ponding.	Severe: flooding, ponding, excess humus.	Severe: flooding, ponding, too clayey.	Poor: too clayey, hard to pack, ponding.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ct:					
Tracosa	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey, excess sodium.	Severe: flooding.	Poor: too clayey, ponding, hard to pack.
Ed Edna	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Es:					
Edna	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Aris	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Fo Follet	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, excess salt.	Severe: flooding.	Poor: ponding, excess sodium, excess salt.
Fr Francitas	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey, excess salt.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
GaB Galveston	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Gc:					
Galveston	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Nass	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess salt.
Gd:					
Galveston	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Urban land.					
Gs Galveston	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ha: Harris	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
ImA, ImB: Ijam	Severe: wetness, percs slowly.	Severe: wetness, flooding.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Iu:					
Ijam	Severe: wetness, percs slowly.	Severe: wetness, flooding.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Urban land.					
Ka: Karankawa	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess salt.
KeA, KeB: Kemah	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: cemented pan, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ku:					
Kemah	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: cemented pan, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Urban land.					
LaA: Lake Charles	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
LaB: Lake Charles	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Lb:					
Lake Charles	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Urban land.					
Le: Leton	Severe: wetness, flooding, percs slowly.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ls:					
Leton	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Aris	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Lx:					
Leton	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Lake Charles	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ma: Mocarey	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, small stones, wetness.
Mb:					
Mocarey	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, small stones, wetness.
Algoa	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: flooding, wetness.	Fair: too clayey, wetness.
Mc:					
Mocarey	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, small stones, wetness.
Cieno	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Md:					
Mocarey	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, small stones, wetness.
Leton	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Me: Morey	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Mf:					
Morey	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Leton	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Mn, Mp, Ms Mustang	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Mt:					
Mustang	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Nass	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess salt.
Mu:					
Mustang	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Urban land.					
Na Narta	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ns Nass	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess salt.
Nx:					
Nass	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess salt.
Galveston	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Pa. Pits					

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Pd----------------- Placedo	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
Sa----------------- Sabine	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
SeB---------------- Sievers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
StA:					
Stowell-----------	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, seepage.	Poor: seepage.
Leton-------------	Severe: wetness, flooding, percs slowly.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness.
Ta----------------- Tatlum	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, excess sodium.	Severe: flooding.	Poor: hard to pack, ponding, excess sodium.
Tc, Tm, Tx--------- Tracosa	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey, excess sodium.	Severe: flooding.	Poor: too clayey, ponding, hard to pack.
Va----------------- Vamont	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ve----------------- Verland	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness.
Vn----------------- Veston	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess salt.	Severe: flooding, wetness.	Poor: hard to pack, wetness, excess salt.
Vs----------------- Veston	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: hard to pack, wetness, excess salt.
Vx:					
Veston, strongly saline-----------	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: hard to pack, wetness, excess salt.

TABLE 12.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Vx:					
Veston, slightly saline	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess salt.	Severe: flooding, wetness.	Poor: hard to pack, wetness, excess salt.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
AaB: Arents	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ar: Aris	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Ba: Bacliff	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Bb. Beaches				
Be: Bernard	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Bn:				
Bernard	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Edna	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Bu:				
Bernard	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Urban land.				
Ca: Caplen	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Ct:				
Caplen	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
Ct:				
Tracosa	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Ed Edna	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Es:				
Edna	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Aris	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Fo Follet	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium, wetness.
Fr Francitas	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
GaB Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Gc:				
Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Nass	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness, excess salt.
Gd:				
Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Urban land.				
Gs Galveston	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Ha Harris	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
ImA, ImB------------- Ijam	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Iu:				
Ijam-----------------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Urban land.				
Ka------------------- Karankawa	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
KeA, KeB------------- Kemah	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Ku:				
Kemah----------------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Urban land.				
LaA, LaB------------- Lake Charles	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Lb:				
Lake Charles---------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Urban land.				
Le------------------- Leton	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Ls:				
Leton----------------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Aris-----------------	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Lx:				
Leton----------------	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
Lx:				
Lake Charles	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ma: Mocarey	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Mb:				
Mocarey	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Algoa	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Mc:				
Mocarey	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Cieno	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Md:				
Mocarey	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Leton	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Me: Morey	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Mf:				
Morey	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Leton	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Mn: Mustang	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Mp: Mustang	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, excess salt, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
Ms:				
Mustang, slightly saline	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Mustang, strongly saline	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, excess salt, wetness.
Mt:				
Mustang	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Nass	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess salt.
Mu:				
Mustang	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Urban land.				
Na Narta	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
Ns Nass	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess salt.
Nx:				
Nass	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess salt.
Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Pa. Pits				
Pd Placedo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Sa Sabine	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
SeB Sievers	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
StA:				
Stowell	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
StA:				
Leton	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Ta Tatlum	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium, wetness.
Tc, Tm, Tx Tracosa	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Va Vamont	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Ve Verland	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Vn Veston	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
Vs Veston	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
Vx:				
Veston, strongly saline	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.
Veston, slightly saline	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation
AaB: Arents	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, slow intake, percs slowly.
Ar: Aris	Slight	Severe: wetness.	Severe: no water.	Percs slowly	Wetness, soil blowing, percs slowly.
Ba: Bacliff	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, slow intake, percs slowly.
Bb. Beaches					
Be: Bernard	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Bn: Bernard	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Edna	Slight	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly	Wetness, percs slowly.
Bu: Bernard	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Urban land.					
Ca: Caplen	Slight	Severe: hard to pack, excess salt, ponding.	Severe: slow refill, salty water.	Ponding, percs slowly, flooding.	Wetness, percs slowly, flooding.
Ct: Caplen	Slight	Severe: hard to pack, excess salt, ponding.	Severe: slow refill, salty water.	Ponding, percs slowly, flooding.	Wetness, percs slowly, flooding.
Tracosa	Slight	Severe: excess sodium, excess salt, ponding.	Severe: salty water, slow refill.	Flooding, percs slowly, excess sodium.	Flooding, percs slowly, excess sodium.
Ed: Edna	Slight	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly	Wetness, percs slowly.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation
Es:					
Edna	Slight	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly	Wetness, percs slowly.
Aris	Slight	Severe: wetness.	Severe: no water.	Percs slowly	Wetness, soil blowing, percs slowly.
Fo Follet	Slight	Severe: excess salt, excess sodium, ponding.	Severe: salty water.	Flooding, percs slowly, excess sodium.	Flooding, percs slowly, excess sodium.
Fr Francitas	Slight	Severe: hard to pack, wetness, excess salt.	Severe: no water.	Wetness, percs slowly, excess salt.	Wetness, excess salt, slow intake.
GaB Galveston	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, soil blowing.
Gc:					
Galveston	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, soil blowing.
Nass	Severe: seepage.	Severe: piping, ponding, excess salt.	Severe: cutbanks cave, salty water.	Ponding, cutbanks cave, flooding.	Ponding, fast intake.
Gd:					
Galveston	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, soil blowing.
Urban land.					
Gs Galveston	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, soil blowing.
Ha Harris	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, excess salt.	Wetness, slow intake, excess salt.
ImA Ijam	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, excess salt.	Wetness, slow intake, percs slowly.
ImB Ijam	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, slope, excess salt.	Wetness, slow intake, percs slowly.
Iu:					
Ijam	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, excess salt.	Wetness, slow intake, percs slowly.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation
Iu: Urban land.					
Ka: Karankawa	Severe: seepage.	Severe: piping, ponding, excess salt.	Severe: salty water, cutbanks cave.	Ponding, flooding, subsides.	Ponding, flooding, excess salt.
KeA, KeB: Kemah	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Ku: Kemah	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Urban land.					
LaA: Lake Charles	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, slow intake, percs slowly.
LaB: Lake Charles	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, slope.	Wetness, slow intake, percs slowly.
Lb: Lake Charles	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, slow intake, percs slowly.
Urban land.					
Le: Leton	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Flooding, percs slowly.	Wetness, percs slowly, flooding.
Ls: Leton	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Aris	Slight	Severe: wetness.	Severe: no water.	Percs slowly	Wetness, soil blowing, percs slowly.
Lx: Leton	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Lake Charles	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, slow intake, percs slowly.
Ma: Mocarey	Slight	Severe: wetness.	Severe: slow refill.	Favorable	Wetness, percs slowly, erodes easily.

TABLE 14.--WATER MANAGEMENT--*Continued*

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation
Mb:					
Mocarey	Slight	Severe: wetness.	Severe: slow refill.	Favorable	Wetness, percs slowly, erodes easily.
Algoa	Slight	Moderate: piping, wetness.	Severe: no water.	Favorable	Wetness, erodes easily.
Mc:					
Mocarey	Slight	Severe: wetness.	Severe: slow refill.	Favorable	Wetness, percs slowly, erodes easily.
Cieno	Slight	Severe: ponding.	Severe: no water.	Ponding, percs slowly.	Ponding, percs slowly.
Md:					
Mocarey	Slight	Severe: wetness.	Severe: slow refill.	Favorable	Wetness, percs slowly, erodes easily.
Leton	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Me Morey	Slight	Severe: wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly, erodes easily.
Mf:					
Morey	Slight	Severe: wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly, erodes easily.
Leton	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly.
Mn Mustang	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.
Mp Mustang	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: salty water, cutbanks cave.	Flooding, cutbanks cave, excess salt.	Wetness, fast intake, excess salt.
Ms:					
Mustang, slightly saline	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.
Mustang, strongly saline	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: salty water, cutbanks cave.	Flooding, cutbanks cave, excess salt.	Wetness, fast intake, excess salt.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation
Mt:					
Mustang	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.
Nass	Severe: seepage.	Severe: piping, ponding, excess salt.	Severe: cutbanks cave, salty water.	Ponding, cutbanks cave, flooding.	Ponding, fast intake.
Mu:					
Mustang	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.
Urban land.					
Na Narta	Slight	Severe: wetness, excess sodium, excess salt.	Severe: no water.	Percs slowly, excess salt, excess sodium.	Wetness, excess sodium, percs slowly.
Ns Nass	Severe: seepage.	Severe: piping, ponding, excess salt.	Severe: cutbanks cave, salty water.	Ponding, cutbanks cave, flooding.	Ponding.
Nx:					
Nass	Severe: seepage.	Severe: piping, ponding, excess salt.	Severe: cutbanks cave, salty water.	Ponding, cutbanks cave, flooding.	Ponding, fast intake.
Galveston	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake, soil blowing.
Pa. Pits					
Pd Placedo	Slight	Severe: hard to pack, ponding, excess salt.	Severe: slow refill, salty water.	Ponding, percs slowly, flooding.	Ponding, droughty, slow intake.
Sa Sabine	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.
SeB Sievers	Slight	Severe: piping.	Severe: slow refill.	Excess salt	Wetness, erodes easily, excess salt.
StA:					
Stowell	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.

TABLE 14.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation
StA:					
Leton	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Flooding, percs slowly.	Wetness, percs slowly, flooding.
Ta Tatlum	Slight	Severe: excess salt, excess sodium, ponding.	Severe: salty water, slow refill.	Flooding, percs slowly.	Flooding, percs slowly, excess sodium.
Tc, Tm, Tx Tracosa	Slight	Severe: excess sodium, excess salt, ponding.	Severe: salty water, slow refill.	Flooding, percs slowly, excess sodium.	Flooding, percs slowly, excess sodium.
Va Vamont	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Wetness, slow intake, percs slowly.
Ve Verland	Slight	Severe: wetness.	Severe: slow refill.	Percs slowly	Wetness, percs slowly, erodes easily.
Vn Veston	Moderate: seepage.	Severe: wetness, excess salt.	Severe: slow refill, salty water.	Percs slowly, flooding, excess salt.	Wetness, percs slowly, excess salt.
Vs Veston	Moderate: seepage.	Severe: piping, wetness, excess sodium.	Severe: salty water.	Flooding, excess salt, excess sodium.	Wetness, flooding, excess sodium.
Vx:					
Veston, strongly saline	Moderate: seepage.	Severe: piping, wetness, excess sodium.	Severe: salty water.	Flooding, excess salt, excess sodium.	Wetness, flooding, excess sodium.
Veston, slightly saline	Moderate: seepage.	Severe: wetness, excess salt.	Severe: slow refill, salty water.	Percs slowly, flooding, excess salt.	Wetness, percs slowly, excess salt.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated. Some soils may have Unified classifications and USDA textures in addition to those shown. In general, the dominant classifications and textures are shown]

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
AaB. Arents	0-60	Clay	CH	A-7	0	100	95-100	80-100	75-100	51-90	37-60
Ar. Aris	0-20	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	98-100	95-100	95-100	40-60	<25	NP-7
	20-32	Sandy clay loam, clay loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	95-100	55-75	39-48	18-25
	32-62	Clay, clay loam, silty clay loam.	CL, CH	A-7	0	100	95-100	95-100	60-80	42-62	21-36
Ba. Bacliff	0-35	Clay	CH	A-7	0	100	85-100	80-100	75-100	55-65	35-45
	35-63	Clay, silty clay	CH	A-7	0	100	90-100	80-100	75-100	60-85	35-60
Bb. Beaches											
Be. Bernard	0-10	Clay loam	CL	A-6, A-7	0	100	98-100	90-100	80-95	30-49	12-28
	10-60	Clay, silty clay, clay loam.	CL, CH	A-7	0	98-100	98-100	90-100	90-100	41-70	22-44
	60-65	Silty clay, silty clay loam, clay loam.	CL, CH	A-7	0	100	93-100	90-100	75-90	41-65	25-45
Bn:											
Bernard	0-10	Clay loam	CL	A-6, A-7	0	100	98-100	90-100	80-95	30-49	12-28
	10-60	Clay, silty clay, clay loam.	CL, CH	A-7	0	98-100	98-100	90-100	90-100	41-70	22-44
Edna	0-8	Fine sandy loam	CL-ML, SM-SC, CL, SC	A-4, A-6	0	100	100	90-100	45-65	23-34	6-15
	8-60	Clay, clay loam	CH	A-7	0	100	98-100	90-100	60-80	50-72	28-46
Bu:											
Bernard	0-10	Clay loam	CL	A-6, A-7	0	100	98-100	90-100	80-95	30-49	12-28
	10-60	Clay, silty clay, clay loam.	CL, CH	A-7	0	98-100	98-100	90-100	90-100	41-70	22-44
Urban land.											
Ca. Caplen	0-16	Mucky silty clay loam.	OH, MH	A-7	0	100	100	100	95-100	50-90	15-45
	16-35	Clay, silty clay, silty clay loam.	MH	A-7	0	100	100	100	95-100	50-90	20-50
	35-60	Clay, clay loam, sandy clay loam.	CH, MH, ML, CL	A-7	0	100	100	90-100	90-100	40-76	15-40
Ct:											
Caplen	0-14	Mucky silty clay loam.	OH, MH	A-7	0	100	100	100	95-100	50-90	15-45
	14-42	Clay, silty clay, silty clay loam.	MH	A-7	0	100	100	100	95-100	50-90	20-50
	42-60	Clay, clay loam, sandy clay loam.	CH, MH, ML, CL	A-7	0	100	100	90-100	90-100	40-76	15-40

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ct:											
Tracosa----------	0-4	Clay--------------	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
	4-60	Clay loam, silty clay loam, clay, silty clay.	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
Ed--------------- Edna	0-8	Fine sandy loam	CL-ML, SM-SC, CL, SC	A-4, A-6	0	100	100	90-100	45-65	23-34	6-15
	8-45	Clay, clay loam	CH	A-7	0	100	98-100	90-100	60-80	50-72	28-46
	45-60	Clay, clay loam	CL, CH	A-7	0	100	98-100	80-100	70-80	41-60	20-36
Es:											
Edna------------	0-8	Fine sandy loam	CL-ML, SM-SC, CL, SC	A-4, A-6	0	100	100	90-100	45-65	23-34	6-15
	8-23	Clay, clay loam	CH	A-7	0	100	98-100	90-100	60-80	50-72	28-46
	23-60	Clay, clay loam	CL, CH	A-7	0	100	98-100	80-100	70-80	41-60	20-36
	50-65	Clay, clay loam, sandy clay loam, sandy clay.	CL, CH	A-7, A-6	0	98-100	98-100	80-100	55-80	30-60	13-35
Aris------------	0-21	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	98-100	95-100	95-100	40-60	<25	NP-7
	21-32	Sandy clay loam, clay loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	95-100	55-75	39-48	18-25
	32-60	Clay, clay loam, silty clay loam.	CL, CH	A-7	0	100	95-100	95-100	60-80	42-62	21-36
Fo--------------- Follet	0-8	Loam-------------	SC, CL, CL-ML, SM-SC	A-4, A-6	0	100	100	70-100	40-85	20-40	5-20
	8-60	Stratified silty clay loam to loam.	CL	A-4, A-6, A-7-6	0	100	100	85-100	51-85	28-44	9-21
Fr--------------- Francitas	0-13	Clay-------------	CH	A-7-6	0	100	100	95-100	80-95	51-65	30-40
	13-73	Clay, silty clay	CH	A-7-6	0	98-100	95-100	95-100	80-95	60-90	40-65
GaB-------------- Galveston	0-6	Fine sand--------	SP-SM, SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-20	<30	NP-3
	6-60	Fine sand, sand	SP-SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-10	<30	NP-3
Gc:											
Galveston-------	0-22	Fine sand--------	SP-SM, SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-20	<30	NP-3
	22-70	Fine sand, sand	SP-SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-10	<30	NP-3
Nass------------	0-6	Very fine sand---	SM	A-4	0-1	90-100	90-100	80-100	36-50	<25	NP-3
	6-60	Loamy very fine sand, very fine sandy loam, very fine sand, loamy fine sand.	SM, ML	A-4	0-1	90-100	90-100	80-100	36-75	<25	NP-3

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Gd: Galveston-------	0-20	Fine sand--------	SP-SM, SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-20	<30	NP-3
	20-60	Fine sand, sand	SP-SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-10	<30	NP-3
Urban land.											
Gs--------------- Galveston	0-21	Loamy fine sand	SM	A-3, A-2-4	0	100	96-100	65-90	15-30	<30	NP-3
	21-60	Fine sand, sand	SP-SM, SP	A-3, A-2-4	0	100	70-85	60-75	2-10	<30	NP-3
Ha--------------- Harris	0-13	Clay-------------	CH	A-7	0	98-100	85-95	70-95	70-95	65-80	40-55
	13-60	Clay, silty clay	CH	A-7	0	98-100	94-100	90-100	80-90	60-75	40-55
ImA-------------- Ijam	0-10	Clay-------------	CH, CL	A-7	0	98-100	90-100	90-99	70-95	45-80	25-55
	10-56	Clay-------------	CH	A-7	0	100	90-100	90-100	80-98	60-85	35-55
	56-61	Sand-------------	SP-SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-10	<30	NP-3
ImB-------------- Ijam	0-12	Clay-------------	CH, CL	A-7	0	98-100	90-100	90-99	70-95	45-80	25-55
	12-60	Clay-------------	CH	A-7	0	100	90-100	90-100	80-98	60-85	35-55
Iu: Ijam------------	0-12	Clay-------------	CH, CL	A-7	0	98-100	90-100	90-99	70-95	45-80	25-55
	12-60	Clay-------------	CH	A-7	0	100	90-100	90-100	80-98	60-85	35-55
Urban land.											
Ka--------------- Karankawa	0-18	Mucky loam, mucky fine sandy loam.	SM, SM-SC, CL-ML, ML	A-4	0	98-100	95-100	70-95	45-75	<25	NP-7
	18-38	Fine sandy loam, loam, very fine sandy loam.	SM, SM-SC, CL-ML, ML	A-4	0	98-100	95-100	70-95	40-75	<25	NP-7
	38-60	Loamy fine sand, loamy very fine sand, very fine sandy loam.	SM, SM-SC, ML, CL-ML	A-4	0	98-100	95-100	65-95	35-65	<20	NP-5
KeA-------------- Kemah	0-15	Silt loam, loam, fine sandy loam.	ML, CL, CL-ML	A-4	0	100	100	90-100	70-90	22-32	3-11
	15-38	Clay, clay loam	CH	A-7-6	0	100	100	90-100	70-95	51-76	30-49
	38-60	Clay, clay loam, sandy clay loam.	CL, CH, SC	A-7-6	0	100	100	80-100	36-95	44-76	22-49
KeB-------------- Kemah	0-17	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	90-100	70-90	22-32	3-11
	17-35	Clay, clay loam	CH	A-7-6	0	100	100	90-100	70-95	51-76	30-49
	35-70	Clay, clay loam, sandy clay loam.	CL, CH, SC	A-7-6	0	100	100	80-100	36-95	44-76	22-49
Ku: Kemah-----------	0-15	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	90-100	70-90	22-32	3-11
	15-38	Clay, clay loam	CH	A-7-6	0	100	100	90-100	70-95	51-76	30-49
	38-60	Clay, clay loam, sandy clay loam.	CL, CH, SC	A-7-6	0	100	100	80-100	36-95	44-76	22-49
Urban land.											

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
LaA-------------	0-24	Clay-------------	CH	A-7	0	100	99-100	80-100	75-100	64-80	40-55
Lake Charles	24-62	Clay-------------	CH	A-7	0	98-100	98-100	80-100	75-100	54-90	37-60
LaB-------------	0-38	Clay-------------	CH	A-7	0	100	99-100	80-100	75-100	64-80	40-55
Lake Charles	38-60	Clay-------------	CH	A-7	0	98-100	98-100	80-100	75-100	54-90	37-60
Lb:											
Lake Charles----	0-38	Clay-------------	CH	A-7	0	100	99-100	80-100	75-100	64-80	40-55
	38-60	Clay-------------	CH	A-7	0	98-100	98-100	80-100	75-100	54-90	37-60
Urban land.											
Le--------------	0-12	Loam, silt loam, very fine sandy loam.	CL, CL-ML, SM-SC, SC	A-4, A-6	0	100	98-100	95-100	45-98	21-30	5-12
Leton	12-60	Clay loam, silty clay loam, sandy clay loam, loam.	CL	A-6, A-7-6	0	100	98-100	95-100	51-98	30-43	14-26
Ls:											
Leton-----------	0-21	Loam-------------	CL, CL-ML, SM-SC, SC	A-4, A-6	0	100	98-100	95-100	45-98	21-30	5-12
	21-60	Clay loam, silty clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	95-100	51-98	30-43	14-26
Aris------------	0-19	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	98-100	95-100	95-100	40-60	<25	NP-7
	19-45	Sandy clay loam, clay loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	95-100	55-75	39-48	18-25
	45-60	Clay, clay loam, silty clay loam.	CL, CH	A-7	0	100	95-100	95-100	60-80	42-62	21-36
Lx:											
Leton-----------	0-20	Loam-------------	CL, CL-ML, SM-SC, SC	A-4, A-6	0	100	98-100	95-100	45-98	21-30	5-12
	20-60	Clay loam, silty clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	95-100	51-98	30-43	14-26
Lake Charles----	0-50	Clay-------------	CH	A-7	0	100	99-100	80-100	75-100	64-80	40-55
	50-62	Clay-------------	CH	A-7	0	98-100	98-100	80-100	75-100	54-90	37-60
Ma--------------	0-12	Loam-------------	CL, CL-ML	A-4, A-6	0	98-100	95-100	70-95	50-75	20-35	5-15
Mocarey	12-22	Loam, silty clay loam, clay loam.	CL	A-4, A-6, A-7-6	0-5	90-100	90-100	85-98	60-95	25-50	8-25
	22-52	Loam, silty clay loam, clay loam.	CL	A-4, A-6	0-5	70-95	70-95	70-95	50-85	25-40	8-18
	52-60	Clay loam, sandy clay loam, clay.	CL, SC	A-6, A-7-6	0-5	95-100	90-100	80-100	35-95	37-50	16-25
Mb:											
Mocarey---------	0-11	Silty clay loam	CL, CL-ML	A-4, A-6	0	98-100	95-100	90-100	70-95	26-40	5-18
	11-60	Loam, silty clay loam, clay loam.	CL	A-4, A-6	0-5	70-95	70-95	70-95	50-85	25-40	8-18
Algoa-----------	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	98-100	95-100	90-100	70-95	26-40	5-18
	12-58	Loam, silt loam, clay loam, silty clay loam.	CL	A-4, A-6	0-5	90-100	90-100	85-100	60-95	25-40	8-18
	58-65	Clay loam, sandy clay loam, clay.	CL, SC	A-6, A-7-6	0-5	95-100	93-100	80-100	35-95	37-50	16-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Mc:											
Mocarey----------	0-12	Loam-------------	CL, CL-ML	A-4, A-6	0	98-100	95-100	70-95	50-75	20-35	5-15
	12-16	Loam, silty clay loam, clay loam.	CL	A-4, A-6, A-7-6	0-5	90-100	90-100	85-98	60-95	25-50	8-25
	16-60	Loam, silty clay loam, clay loam.	CL	A-4, A-6	0-5	70-95	70-95	70-95	50-85	25-40	8-18
Cieno------------	0-11	Silt loam--------	CL	A-6	0	98-100	95-100	85-100	51-70	28-40	15-25
	11-60	Sandy clay loam, clay loam.	CL	A-6, A-7-6	0	98-100	95-100	90-100	60-85	32-42	20-30
Md:											
Mocarey----------	0-12	Loam-------------	CL, CL-ML	A-4, A-6	0	98-100	95-100	70-95	50-75	20-35	5-15
	12-24	Loam, silty clay loam, clay loam.	CL	A-4, A-6, A-7-6	0-5	90-100	90-100	85-98	60-95	25-50	8-25
	24-60	Loam, silty clay loam, clay loam.	CL	A-4, A-6	0-5	70-95	70-95	70-95	50-85	25-40	8-18
Leton------------	0-20	Loam-------------	CL, CL-ML, SM-SC, SC	A-4, A-6	0	100	98-100	95-100	45-98	21-30	5-12
	20-60	Clay loam, silty clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	95-100	51-98	30-43	14-26
Me--------------- Morey	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	75-95	23-40	5-18
	11-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	95-100	90-100	85-95	34-50	14-30
Mf:											
Morey------------	0-11	Loam-------------	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	75-95	23-40	5-18
	11-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	95-100	90-100	85-95	34-50	14-30
Leton------------	0-12	Loam-------------	CL, CL-ML, SM-SC, SC	A-4, A-6	0	100	98-100	95-100	45-98	21-30	5-12
	12-60	Clay loam, silty clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	95-100	51-98	30-43	14-26
Mn--------------- Mustang	0-7	Fine sand--------	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
	7-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
Mp--------------- Mustang	0-13	Fine sand--------	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
	13-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
Ms:											
Mustang, slightly saline	0-18	Fine sand--------	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
	18-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
Mustang, strongly saline	0-6	Fine sand--------	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
	6-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Mt:											
Mustang---------	0-14	Fine sand--------	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
	14-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
Nass------------	0-4	Loamy very fine sand.	SM	A-4	0-1	90-100	90-100	80-100	36-50	<25	NP-3
	4-60	Loamy very fine sand, very fine sandy loam, very fine sand.	SM, ML	A-4	0-1	90-100	90-100	80-100	36-75	<25	NP-3
Mu:											
Mustang---------	0-18	Fine sand--------	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
	18-60	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	0-3	85-100	80-100	60-80	2-12	<25	NP-3
Urban land.											
Na--------------- Narta	0-9	Fine sandy loam	SC, CL, SM, ML	A-4, A-6	0	100	100	100	36-75	<30	NP-15
	9-60	Silty clay, clay, clay loam, silty clay loam.	CH, CL	A-7-6	0	98-100	95-100	90-100	60-80	48-66	35-45
Ns--------------- Nass	0-27	Very fine sandy loam.	ML	A-4	0-1	90-100	90-100	90-100	51-75	<25	NP-3
	27-65	Loamy very fine sand, very fine sandy loam, very fine sand.	SM, ML	A-4	0-1	90-100	90-100	80-100	36-75	<25	NP-3
Nx:											
Nass------------	0-10	Loamy very fine sand.	SM	A-4	0-1	90-100	90-100	80-100	36-50	<25	NP-3
	10-60	Loamy very fine sand, very fine sandy loam, very fine sand, loamy fine sand.	SM, ML	A-4	0-1	90-100	70-85	60-75	36-75	<25	NP-3
Galveston-------	0-11	Fine sand--------	SP-SM, SM, SP	A-3, A-2-4	0	100	96-100	65-90	2-20	<30	NP-3
	11-60	Fine sand, sand	SP-SM, SP	A-3, A-2-4	0	100	70-85	60-75	2-10	<30	NP-3
Pa. Pits											
Pd--------------- Placedo	0-36	Clay-------------	CL, CH	A-7-6	0	100	98-100	95-100	85-100	45-70	25-45
	36-60	Stratified clay to fine sandy loam.	CL, CH	A-6, A-7-6	0	100	98-100	95-100	75-100	35-60	20-40
Sa--------------- Sabine	0-14	Loamy fine sand	SP-SM, SM, SP	A-3, A-2-4	0	100	95-100	65-90	2-20	<30	NP-3
	14-75	Fine sand, loamy fine sand.	SP-SM, SM, SP	A-3, A-2-4	0	100	95-100	65-90	2-20	<20	NP-3

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
SeB-------------- Sievers	0-12	Loam-------------	CL	A-4, A-6	0	96-100	96-100	85-100	60-90	22-40	8-20
	12-30	Loam, silt loam, clay loam, silty clay loam.	CL	A-6, A-7	0	96-100	96-100	85-100	60-95	28-50	10-28
	30-60	Loam, fine sandy loam, sandy clay loam.	SM-SC, CL-ML, SC, CL	A-4, A-6, A-7	0	96-100	96-100	70-95	40-75	20-45	5-25
StA: Stowell---------	0-26	Loamy fine sand	SM, SP-SM	A-2-4	0	95-100	80-100	70-85	10-25	<25	NP-3
	26-62	Fine sandy loam, sandy clay loam.	CL	A-6, A-7	0	95-100	90-100	80-90	51-80	30-50	15-30
Leton-----------	0-13	Loam-------------	CL, CL-ML, SM-SC, SC	A-4, A-6	0	100	98-100	95-100	45-98	21-30	5-12
	13-60	Clay loam, silty clay loam, sandy clay loam.	CL	A-6, A-7-6	0	100	98-100	95-100	51-98	30-43	14-26
Ta--------------- Tatlum	0-38	Mucky clay loam	CL	A-6, A-7-6	0	100	100	90-100	70-95	33-46	12-23
	38-60	Stratified very fine sandy loam to clay.	CL, CH	A-6, A-7	0	100	100	90-100	51-98	30-55	11-30
Tc--------------- Tracosa	0-4	Clay-------------	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
	4-60	Clay loam, silty clay loam, clay, silty clay.	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
Tm--------------- Tracosa	0-12	Mucky clay-------	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
	12-60	Clay loam, silty clay loam, clay, silty clay.	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
Tx: Tracosa, mucky clay-----------	0-8	Mucky clay-------	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
	8-60	Clay loam, silty clay loam, clay, silty clay.	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
Tracosa, clay---	0-4	Clay-------------	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
	4-62	Clay loam, silty clay loam, clay, silty clay.	CH, CL	A-7-6, A-6	0	100	100	90-100	80-95	39-66	18-39
Va--------------- Vamont	0-6	Clay-------------	CH	A-7	0	100	85-100	65-75	60-70	58-66	35-41
	6-62	Clay, silty clay	CH	A-7	0	100	90-100	70-80	65-75	62-76	38-49
Ve--------------- Verland	0-6	Silty clay loam	CH, CL	A-6, A-7-6	0	100	100	90-100	70-95	36-56	17-33
	6-30	Clay, silty clay	CH	A-7-6	0	100	100	90-100	75-95	56-76	33-49
	30-60	Clay, clay loam, sandy clay, silty clay loam.	CH, CL	A-6, A-7-6	0	100	100	80-100	55-95	42-76	22-49

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Vn---------------- Veston	0-13	Loam-------------	ML, CL-ML	A-4, A-6	0	98-100	98-100	80-100	51-85	<30	NP-15
	13-68	Stratified silty clay loam to fine sandy loam.	CL, CH	A-6, A-7	0	98-100	98-100	90-100	80-95	28-55	13-35
Vs---------------- Veston	0-10	Loam-------------	ML, CL-ML	A-4	0	98-100	98-100	80-100	51-85	20-30	5-15
	10-60	Stratified silty clay loam to fine sandy loam.	CL, CH	A-6, A-7-6	0	98-100	98-100	90-100	80-95	40-55	20-35
Vx:											
Veston, strongly saline----------	0-10	Loam-------------	ML, CL-ML	A-4	0	98-100	98-100	80-100	51-85	20-30	5-15
	10-28	Stratified silt loam to fine sandy loam.	CL-ML, CL	A-4, A-6	0	98-100	98-100	85-100	60-85	20-30	5-15
	28-60	Stratified silty clay loam to fine sandy loam.	CL, CH	A-6, A-7-6	0	98-100	98-100	90-100	80-95	40-55	20-35
	60-65	Clay-------------	CH	A-7-6	0	98-100	98-100	90-100	85-95	51-65	28-37
Veston, slightly saline----------	0-10	Loam-------------	ML, CL-ML	A-4, A-6	0	98-100	98-100	80-100	51-85	<30	NP-15
	10-28	Stratified silt loam to fine sandy loam.	CL-ML, CL	A-4, A-6	0	98-100	98-100	85-100	60-85	20-32	5-15
	28-60	Stratified silty clay loam to fine sandy loam.	CL, CH	A-6, A-7	0	98-100	98-100	90-100	80-95	28-55	13-35

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
									K	T	
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm				Pct
AaB--------------- Arents	0-60	40-60	1.20-1.45	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.32	5	<2
Ar--------------- Aris	0-20	10-20	1.35-1.55	0.6-2.0	0.11-0.15	5.6-7.3	<2	Low---------	0.37	5	<2
	20-32	25-35	1.30-1.50	0.2-0.6	0.12-0.17	5.1-7.3	<2	Moderate----	0.32		
	32-62	35-50	1.40-1.60	<0.06	0.12-0.18	5.1-7.8	<2	High--------	0.32		
Ba--------------- Bacliff	0-35	40-55	1.30-1.40	0.06-0.2	0.15-0.20	5.6-7.8	<2	High--------	0.32	5	1-4
	35-63	40-60	1.30-1.50	<0.06	0.15-0.20	5.6-8.4	<2	High--------	0.32		
Bb. Beaches											
Be--------------- Bernard	0-10	27-35	1.20-1.45	0.06-0.2	0.15-0.20	5.6-7.3	<2	Moderate----	0.32	5	2-6
	10-60	35-60	1.20-1.45	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
	60-65	30-60	1.30-1.50	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.32		
Bn:											
Bernard---------	0-10	27-35	1.20-1.45	0.06-0.2	0.15-0.20	5.6-7.3	<2	Moderate----	0.32	5	2-6
	10-60	35-60	1.20-1.45	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
Edna------------	0-8	12-20	1.40-1.60	0.6-2.0	0.10-0.15	5.6-7.3	<2	Low---------	0.37	5	.5-3
	8-60	35-55	1.35-1.55	<0.06	0.15-0.20	5.6-7.3	<2	High--------	0.37		
Bu:											
Bernard---------	0-10	27-35	1.20-1.45	0.06-0.2	0.15-0.20	5.6-7.3	<2	Moderate----	0.32	5	2-6
	10-60	35-60	1.20-1.45	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
Urban land.											
Ca--------------- Caplen	0-16	30-55	1.00-1.20	0.06-0.2	0.12-0.25	6.6-8.4	4-16	Low---------	0.49	5	5-15
	16-35	40-60	1.10-1.30	<0.06	0.05-0.15	6.6-8.4	4-16	Low---------	0.32		
	35-60	27-60	1.10-1.30	<0.06	0.05-0.12	6.6-8.4	4-16	Low---------	0.32		
Ct:											
Caplen----------	0-14	30-55	1.00-1.20	0.06-0.2	0.12-0.25	6.6-8.4	4-16	Low---------	0.49	5	5-15
	14-42	40-60	1.10-1.30	<0.06	0.05-0.15	6.6-8.4	4-16	Low---------	0.32		
	42-60	27-60	1.10-1.30	<0.06	0.05-0.12	6.6-8.4	4-16	Low---------	0.32		
Tracosa---------	0-4	35-60	1.05-1.20	<0.06	0.01-0.03	6.6-8.4	>16	High--------	0.37	5	2-15
	4-60	35-60	1.10-1.30	<0.06	0.01-0.03	6.6-8.4	>16	High--------	0.37		
Ed--------------- Edna	0-8	12-20	1.40-1.60	0.6-2.0	0.10-0.15	5.6-7.3	<2	Low---------	0.37	5	.5-3
	8-45	35-55	1.35-1.55	<0.06	0.15-0.20	5.6-7.3	<2	High--------	0.37		
	45-60	35-55	1.35-1.55	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.37		
Es:											
Edna------------	0-8	12-20	1.40-1.60	0.6-2.0	0.10-0.15	5.6-7.3	<2	Low---------	0.37	5	.5-3
	8-23	35-55	1.35-1.55	<0.06	0.15-0.20	5.6-7.3	<2	High--------	0.37		
	23-60	35-55	1.35-1.55	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.37		
	50-65	30-55	1.30-1.60	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.37		
Aris------------	0-21	10-20	1.35-1.55	0.6-2.0	0.11-0.15	5.6-7.3	<2	Low---------	0.37	5	<2
	21-32	25-35	1.30-1.50	0.2-0.6	0.12-0.17	5.1-6.5	<2	Moderate----	0.32		
	32-60	35-50	1.40-1.60	<0.06	0.12-0.18	5.1-7.3	<2	High--------	0.32		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm				Pct
Fo--------------- Follet	0-8	15-35	1.10-1.30	<0.06	0.01-0.03	6.6-8.4	>16	Moderate----	0.43	5	1-15
	8-60	18-35	1.10-1.40	<0.06	0.01-0.03	6.6-8.4	>16	Moderate----	0.43		
Fr--------------- Francitas	0-13	40-50	1.30-1.50	<0.06	0.10-0.18	6.1-8.4	<4	High--------	0.32	5	1-4
	13-73	40-60	1.30-1.50	<0.06	0.06-0.12	6.6-8.4	4-25	Very high	0.32		
GaB-------------- Galveston	0-6	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15	5	<.5
	6-60	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15		
Gc:											
Galveston-------	0-22	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15	5	<.5
	22-70	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15		
Nass------------	0-6	2-10	1.20-1.40	6.0-20	0.04-0.10	6.6-8.4	2-16	Low---------	0.37	5	<1
	6-60	2-10	1.30-1.50	6.0-20	0.04-0.10	6.6-8.4	>4	Low---------	0.49		
Gd:											
Galveston-------	0-20	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15	5	<.5
	20-60	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15		
Urban land.											
Gs--------------- Galveston	0-21	2-8	1.50-1.70	6.0-20	0.05-0.10	6.6-8.4	<4	Low---------	0.15	5	<.5
	21-60	2-8	1.50-1.70	6.0-20	0.05-0.10	7.4-8.4	<4	Low---------	0.15		
Ha--------------- Harris	0-13	40-60	1.10-1.30	0.06-0.2	0.02-0.20	6.6-9.0	4-16	High--------	0.20	5	2-15
	13-60	40-60	1.10-1.30	<0.06	0.01-0.10	6.6-9.0	4-16	High--------	0.32		
ImA-------------- Ijam	0-10	20-50	1.30-1.50	<0.06	0.10-0.12	6.6-9.0	4-16	High--------	0.32	5	<1
	10-56	40-55	1.30-1.50	<0.06	0.10-0.12	6.6-9.0	4-16	High--------	0.32		
	56-61	2-10	1.50-1.70	6.0-20	0.05-0.10	7.8-9.0	4-16	Low---------	0.15		
ImB-------------- Ijam	0-12	20-50	1.30-1.50	<0.06	0.10-0.12	6.6-9.0	4-16	High--------	0.32	5	<1
	12-60	40-55	1.30-1.50	<0.06	0.10-0.12	6.6-9.0	4-16	High--------	0.32		
Iu:											
Ijam------------	0-12	20-50	1.30-1.50	<0.06	0.10-0.12	6.6-9.0	4-16	High--------	0.32	5	<1
	12-60	40-55	1.30-1.50	<0.06	0.10-0.12	6.6-9.0	4-16	High--------	0.32		
Urban land.											
Ka--------------- Karankawa	0-18	5-20	1.10-1.40	2.0-6.0	0.01-0.03	6.6-8.4	>16	Low---------	0.32	5	5-20
	18-38	5-20	1.20-1.40	6.0-20	0.01-0.03	6.6-8.4	>16	Low---------	0.32		
	38-60	3-15	1.20-1.40	6.0-20	0.01-0.03	6.6-8.4	>16	Low---------	0.32		
KeA-------------- Kemah	0-15	15-27	1.35-1.55	0.2-0.6	0.15-0.20	5.1-7.3	<2	Low---------	0.43	5	0-3
	15-38	35-60	1.30-1.50	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
	38-60	25-60	1.40-1.60	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
KeB-------------- Kemah	0-17	15-27	1.35-1.55	0.2-0.6	0.15-0.20	5.1-7.3	<2	Low---------	0.43	5	0-3
	17-35	35-60	1.30-1.50	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
	35-70	25-60	1.40-1.60	<0.06	0.12-0.18	5.6-8.4	<2	High--------	0.32		
Ku:											
Kemah-----------	0-15	15-27	1.35-1.55	0.2-0.6	0.15-0.20	5.1-7.3	<2	Low---------	0.43	5	0-3
	15-38	35-60	1.30-1.50	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
	38-60	25-60	1.40-1.60	<0.06	0.12-0.18	5.6-7.8	<2	High--------	0.32		
Urban land.											
LaA-------------- Lake Charles	0-24	40-60	1.20-1.45	0.06-0.2	0.15-0.20	5.6-7.8	<2	High--------	0.32	5	2-6
	24-62	40-60	1.20-1.45	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.32		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
									K	T	
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm				Pct
LaB----------------	0-38	40-60	1.20-1.45	0.06-0.2	0.15-0.20	5.6-7.8	<2	High--------	0.32	5	2-6
Lake Charles	38-60	40-60	1.20-1.45	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.32		
Lb:											
Lake Charles----	0-38	40-60	1.20-1.45	0.06-0.2	0.15-0.20	5.6-7.8	<2	High--------	0.32	5	2-6
	38-60	40-60	1.20-1.45	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.32		
Urban land.											
Le----------------	0-12	10-25	1.20-1.50	0.6-2.0	0.15-0.20	5.1-7.3	<2	Low---------	0.43	5	1-3
Leton	12-60	20-35	1.30-1.60	0.06-0.2	0.15-0.20	5.6-8.4	<2	Moderate----	0.37		
Ls:											
Leton-----------	0-21	10-25	1.20-1.50	0.6-2.0	0.15-0.20	5.1-7.3	<2	Low---------	0.43	5	1-3
	21-60	20-35	1.30-1.60	0.06-0.2	0.15-0.22	5.6-8.4	<2	Moderate----	0.37		
Aris------------	0-19	10-20	1.35-1.55	0.6-2.0	0.11-0.15	5.6-7.3	<2	Low---------	0.37	5	<2
	19-45	25-35	1.30-1.50	0.2-0.6	0.12-0.17	5.1-8.4	<2	Moderate----	0.32		
	45-60	35-50	1.40-1.60	<0.06	0.12-0.18	5.1-8.4	<2	High--------	0.32		
Lx:											
Leton-----------	0-20	10-25	1.20-1.50	0.6-2.0	0.15-0.20	5.1-7.3	<2	Low---------	0.43	5	1-3
	20-60	20-35	1.30-1.60	0.06-0.2	0.15-0.20	5.6-8.4	<2	Moderate----	0.37		
Lake Charles----	0-50	40-60	1.20-1.45	0.06-0.2	0.15-0.20	5.6-7.8	<2	High--------	0.32	5	2-6
	50-62	40-60	1.20-1.45	<0.06	0.15-0.20	6.6-8.4	<2	High--------	0.32		
Ma----------------	0-12	15-27	1.40-1.60	0.6-2.0	0.12-0.18	6.1-8.4	<2	Low---------	0.37	5	1-4
Mocarey	12-22	18-35	1.50-1.65	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate----	0.37		
	22-52	18-40	1.55-1.70	0.2-0.6	0.15-0.22	7.9-8.4	<2	Low---------	0.37		
	52-60	30-50	1.55-1.70	0.06-0.2	0.12-0.20	6.6-8.4	<2	Moderate----	0.37		
Mb:											
Mocarey---------	0-11	15-30	1.40-1.60	0.6-2.0	0.14-0.24	6.1-8.4	<2	Low---------	0.43	5	1-4
	11-60	18-40	1.55-1.70	0.2-0.6	0.15-0.22	7.9-8.4	<2	Low---------	0.37		
Algoa-----------	0-12	15-30	1.35-1.60	0.6-2.0	0.14-0.24	6.1-8.4	<2	Low---------	0.43	5	1-4
	12-58	20-35	1.50-1.70	0.2-0.6	0.15-0.22	7.4-8.4	<2	Low---------	0.32		
	58-65	30-50	1.50-1.70	0.2-0.6	0.12-0.20	6.6-8.4	<2	Moderate----	0.32		
Mc:											
Mocarey---------	0-12	15-27	1.40-1.60	0.6-2.0	0.12-0.18	6.1-8.4	<2	Low---------	0.37	5	1-4
	12-16	18-35	1.50-1.65	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate----	0.37		
	16-60	18-40	1.55-1.70	0.2-0.6	0.15-0.22	7.9-8.4	<2	Low---------	0.37		
Cieno-----------	0-11	20-30	1.40-1.60	0.2-0.6	0.12-0.18	5.6-7.3	<2	Moderate----	0.32	5	1-3
	11-60	24-35	1.40-1.65	<0.06	0.12-0.18	6.1-8.4	<2	Moderate----	0.32		
Md:											
Mocarey---------	0-12	15-27	1.40-1.60	0.6-2.0	0.12-0.18	6.1-8.4	<2	Low---------	0.37	5	1-4
	12-24	18-35	1.50-1.65	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate----	0.37		
	24-60	18-40	1.55-1.70	0.2-0.6	0.15-0.22	7.9-8.4	<2	Low---------	0.37		
Leton-----------	0-20	10-25	1.20-1.50	0.6-2.0	0.15-0.20	5.1-7.3	<2	Low---------	0.43	5	1-3
	20-60	20-35	1.30-1.60	0.06-0.2	0.15-0.20	5.6-8.4	<2	Moderate----	0.37		
Me----------------	0-11	15-30	1.25-1.50	0.6-2.0	0.16-0.24	5.1-7.3	<2	Low---------	0.37	5	1-4
Morey	11-60	25-35	1.25-1.50	0.06-0.2	0.18-0.22	5.6-8.4	<2	Moderate----	0.37		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm				Pct
Mf:											
Morey	0-11	15-30	1.25-1.50	0.6-2.0	0.16-0.24	5.1-7.3	<2	Low	0.37	5	1-4
	11-60	25-35	1.25-1.50	0.06-0.2	0.18-0.22	5.6-8.4	<2	Moderate	0.37		
Leton	0-12	10-25	1.20-1.50	0.6-2.0	0.15-0.20	5.1-7.3	<2	Low	0.43	5	1-3
	12-60	20-35	1.30-1.60	0.06-0.2	0.15-0.20	5.6-8.4	<2	Moderate	0.37		
Mn Mustang	0-7	2-8	1.40-1.60	6.0-20	0.01-0.07	6.6-8.4	<4	Low	0.15	5	<1
	7-60	2-8	1.40-1.60	6.0-20	0.01-0.06	6.6-8.4	<8	Low	0.15		
Mp Mustang	0-13	2-8	1.40-1.60	6.0-20	0.01-0.04	6.6-8.4	>4	Low	0.15	5	<1
	13-60	2-8	1.40-1.60	6.0-20	0.01-0.04	6.6-8.4	>4	Low	0.15		
Ms:											
Mustang, slightly saline	0-18	2-8	1.40-1.60	6.0-20	0.01-0.07	6.6-8.4	<4	Low	0.15	5	<1
	18-60	2-8	1.40-1.60	6.0-20	0.01-0.06	6.6-8.4	<8	Low	0.15		
Mustang, strongly saline	0-6	2-8	1.40-1.60	6.0-20	0.01-0.04	6.6-8.4	>4	Low	0.15	5	<1
	6-60	2-8	1.40-1.60	6.0-20	0.01-0.04	6.6-8.4	>4	Low	0.15		
Mt:											
Mustang	0-14	2-8	1.40-1.60	6.0-20	0.01-0.07	6.6-8.4	<4	Low	0.15	5	<1
	14-60	2-8	1.40-1.60	6.0-20	0.01-0.06	6.6-8.4	<8	Low	0.15		
Nass	0-4	2-10	1.20-1.40	6.0-20	0.04-0.10	6.6-8.4	2-16	Low	0.37	5	<1
	4-60	2-10	1.30-1.50	6.0-20	0.04-0.10	6.6-8.4	>4	Low	0.49		
Mu:											
Mustang	0-18	2-8	1.40-1.60	6.0-20	0.01-0.07	6.6-8.4	<4	Low	0.15	5	<1
	18-60	2-8	1.40-1.60	6.0-20	0.01-0.06	6.6-8.4	<8	Low	0.15		
Urban land.											
Na Narta	0-9	10-20	1.40-1.60	0.6-2.0	0.05-0.11	6.6-8.4	2-16	Low	0.49	5	.5-2
	9-60	35-45	1.45-1.65	<0.06	0.-0.02	7.4-8.4	>8	High	0.43		
Ns Nass	0-27	2-10	1.20-1.40	6.0-20	0.04-0.10	6.6-8.4	2-16	Low	0.49	5	<1
	27-65	2-10	1.30-1.50	6.0-20	0.04-0.10	6.6-8.4	>4	Low	0.49		
Nx:											
Nass	0-10	2-10	1.20-1.40	6.0-20	0.04-0.10	6.6-8.4	2-16	Low	0.37	5	<1
	10-60	2-10	1.30-1.50	6.0-20	0.04-0.10	6.6-8.4	>4	Low	0.49		
Galveston	0-11	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15	5	<.5
	11-60	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low	0.15		
Pa. Pits											
Pd Placedo	0-36	35-50	1.10-1.30	<0.06	0.-0.05	7.4-8.4	>8	High	0.37	5	1-10
	36-60	20-50	1.10-1.40	<0.06	0.-0.01	7.4-8.4	>16	Moderate	0.37		
Sa Sabine	0-14	2-10	1.30-1.50	6.0-20	0.07-0.12	5.6-8.4	<2	Low	0.15	5	1-2
	14-75	2-10	1.40-1.60	6.0-20	0.05-0.10	5.6-8.4	<2	Low	0.15		
SeB Sievers	0-12	10-25	1.20-1.50	0.6-2.0	0.10-0.15	6.1-8.4	2-16	Low	0.37	5	<1
	12-30	18-35	1.30-1.60	0.2-0.6	0.08-0.15	6.1-8.4	4-16	Moderate	0.37		
	30-60	12-30	1.30-1.60	0.2-0.6	0.06-0.15	6.1-8.4	4-16	Low	0.37		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
									K	T	
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm				Pct
StA:											
Stowell----------	0-26	2-12	1.40-1.60	2.0-6.0	0.07-0.11	5.1-6.5	<2	Low----------	0.15	5	1-2
	26-62	18-35	1.45-1.65	0.6-2.0	0.12-0.17	5.1-6.5	<2	Moderate----	0.24		
Leton------------	0-13	10-25	1.20-1.50	0.6-2.0	0.15-0.20	5.1-7.3	<2	Low----------	0.43	5	1-3
	13-60	20-35	1.30-1.60	0.06-0.2	0.15-0.20	5.6-8.4	<2	Moderate----	0.37		
Ta---------------	0-38	27-35	1.05-1.20	<0.06	0.01-0.03	6.6-8.4	>16	Moderate----	0.43	5	2-15
Tatlum	38-60	18-35	1.10-1.30	<0.06	0.01-0.03	6.6-8.4	>16	Moderate----	0.43		
Tc---------------	0-4	35-60	1.05-1.20	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37	5	2-4
Tracosa	4-60	35-60	1.10-1.30	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37		
Tm---------------	0-12	35-60	1.05-1.20	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37	5	4-15
Tracosa	12-60	35-60	1.10-1.30	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37		
Tx:											
Tracosa, mucky clay-----------	0-8	35-60	1.05-1.20	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37	5	4-15
	8-60	35-60	1.10-1.30	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37		
Tracosa, clay---	0-4	35-60	1.05-1.20	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37	5	2-4
	4-62	35-60	1.10-1.30	<0.06	0.01-0.03	6.6-8.4	>16	High---------	0.37		
Va---------------	0-6	40-60	1.15-1.40	0.06-0.2	0.15-0.2	5.1-7.3	<2	High---------	0.32	5	.5-2
Vamont	6-62	45-60	1.20-1.45	<0.06	0.15-0.2	5.1-7.3	<2	High---------	0.32		
Ve---------------	0-13	27-40	1.30-1.50	0.06-0.2	0.15-0.22	5.6-7.8	<2	Moderate----	0.37	5	1-4
Verland	13-62	40-60	1.30-1.50	<0.06	0.12-0.18	5.6-8.4	<2	High---------	0.32		
	30-60	35-60	1.40-1.60	<0.06	0.15-0.22	5.6-8.4	<2	High---------	0.32		
Vn---------------	0-13	15-27	1.20-1.40	0.6-2.0	0.05-0.15	6.6-8.4	4-8	Low----------	0.49	5	<1
Veston	13-68	15-35	1.20-1.50	0.06-0.2	0.02-0.10	7.9-9.0	>8	Moderate----	0.32		
Vs---------------	0-10	15-27	1.20-1.40	0.6-2.0	0.02-0.10	6.6-8.4	>8	Low----------	0.49	5	<1
Veston	10-60	15-35	1.20-1.50	0.06-0.2	0.02-0.10	7.9-9.0	>8	Moderate----	0.32		
Vx:											
Veston, strongly saline---------	0-10	15-27	1.20-1.40	0.6-2.0	0.02-0.10	6.6-8.4	>8	Low----------	0.49	5	<1
	10-28	12-27	1.20-1.50	0.6-2.0	0.02-0.10	7.9-9.0	>8	Low----------	0.49		
	28-60	15-35	1.20-1.50	0.06-0.2	0.02-0.10	7.9-9.0	>8	Moderate----	0.32		
	60-65	40-55	1.20-1.45	<0.06	0.02-0.10	7.9-9.0	>8	High---------	0.32		
Veston, slightly saline---------	0-10	15-27	1.20-1.40	0.6-2.0	0.05-0.15	6.6-8.4	2-4	Low----------	0.49	5	<1
	10-28	12-27	1.20-1.50	0.6-2.0	0.02-0.10	7.9-9.0	>8	Low----------	0.49		
	28-60	15-35	1.20-1.50	0.06-0.2	0.02-0.10	7.9-9.0	>8	Moderate----	0.32		

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," "perched," and other terms are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Subsidence		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total	Uncoated steel	Concrete
					Ft			In	In		
AaB------------ Arents	D	Rare-------	---	---	1.0-2.0	Apparent	Dec-Feb	---	---	High-----	Low.
Ar------------- Aris	D	Rare-------	---	---	0.5-2.0	Perched	Nov-Mar	---	---	High-----	Moderate.
Ba------------- Bacliff	D	Rare-------	---	---	0-1.0	Apparent	Nov-Mar	---	---	High-----	Low.
Bb. Beaches											
Be------------- Bernard	D	Rare-------	---	---	0-2.0	Apparent	Dec-Feb	---	---	High-----	Low.
Bn: Bernard-------	D	Rare-------	---	---	0-2.0	Apparent	Dec-Feb	---	---	High-----	Low.
Edna----------	D	Rare-------	---	---	0-1.5	Perched	Dec-Mar	---	---	High-----	Low.
Bu: Bernard-------	D	Rare-------	---	---	0-2.0	Apparent	Dec-Feb	---	---	High-----	Low.
Urban land.											
Ca*------------ Caplen	D	Frequent---	Very long.	Jan-Dec	+2-0	Apparent	Jan-Dec	6-12	6-12	High-----	High.
Ct*: Caplen--------	D	Frequent---	Very long.	Jan-Dec	+2-0	Apparent	Jan-Dec	6-12	6-12	High-----	High.
Tracosa-------	D	Frequent---	Very long.	Jan-Dec	0-0.5	Apparent	Jan-Dec	1-2	1-2	High-----	High.
Ed------------- Edna	D	Rare-------	---	---	0-1.5	Perched	Dec-Mar	---	---	High-----	Low.
Es: Edna----------	D	Rare-------	---	---	0-1.5	Perched	Dec-Mar	---	---	High-----	Low.
Aris----------	D	Rare-------	---	---	0.5-1.5	Perched	Nov-Mar	---	---	High-----	Moderate.
Fo------------- Follet	D	Frequent---	Very long.	Jan-Dec	0-0.5	Apparent	Jan-Dec	1-4	1-4	High-----	High.
Fr------------- Francitas	D	Rare-------	---	---	0-1.0	Perched	Dec-Mar	---	---	High-----	Low.
GaB------------ Galveston	A	Occasional	Very brief.	Jun-Oct	3.0-5.0	Apparent	Jan-Dec	---	---	High-----	Low.
Gc: Galveston-----	A	Occasional	Very brief.	Jun-Oct	3.0-5.0	Apparent	Jan-Dec	---	---	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Subsidence		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total	Uncoated steel	Concrete
					Ft			In	In		
Gc*:											
Nass----------	D	Occasional	Brief	Jun-Nov	+2-0	Apparent	Jan-Dec	---	---	High-----	Low.
Gd:											
Galveston-----	A	Occasional	Very brief.	Jun-Oct	2.0-5.0	Apparent	Jan-Dec	---	---	High-----	Low.
Urban land.											
Gs------------ Galveston	A	Occasional	Very brief.	Jun-Oct	2.5-4.0	Apparent	Jan-Dec	---	---	High-----	Low.
Ha------------ Harris	D	Occasional	Long---	Sep-Jun	0-0.5	Apparent	Sep-Jun	---	---	High-----	High.
ImA, ImB------- Ijam	D	Rare-------	---	---	0-3.0	Apparent	Sep-May	---	---	High-----	High.
Iu:											
Ijam----------	D	Rare-------	---	---	0-3.0	Apparent	Sep-May	---	---	High-----	High.
Urban land.											
Ka*----------- Karankawa	D	Frequent---	Very long.	Jan-Dec	+1-0	Apparent	Jan-Dec	1-4	1-4	High-----	High.
KeA, KeB------- Kemah	D	Rare-------	---	---	0.5-1.5	Apparent	Nov-Mar	---	---	High-----	Moderate.
Ku:											
Kemah---------	D	Rare-------	---	---	0.5-1.5	Apparent	Nov-Mar	---	---	High-----	Moderate.
Urban land.											
LaA, LaB------- Lake Charles	D	Rare-------	---	---	0-2.0	Apparent	Dec-Feb	---	---	High-----	Low.
Lb:											
Lake Charles--	D	Rare-------	---	---	0-1.5	Apparent	Dec-Feb	---	---	High-----	Low.
Urban land.											
Le------------ Leton	D	Occasional	Very brief to very long.	Oct-May	0-1.5	Apparent	Oct-May	---	---	High-----	Moderate.
Ls:											
Leton---------	D	Rare-------	---	---	0-0.5	Apparent	Oct-May	---	---	High-----	Moderate.
Aris----------	D	Rare-------	---	---	0.5-2.0	Perched	Nov-Mar	---	---	High-----	Moderate.
Lx:											
Leton---------	D	Rare-------	---	---	0-0.5	Apparent	Oct-May	---	---	High-----	Moderate.
Lake Charles--	D	Rare-------	---	---	0-1.5	Apparent	Dec-Feb	---	---	High-----	Low.
Ma------------ Mocarey	D	Rare-------	---	---	1.5-2.0	Apparent	Nov-Apr	---	---	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Subsidence		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Initial	Total	Uncoated steel	Concrete
					Ft			In	In		
Mb:											
Mocarey-------	D	Rare-------	---	---	1.5-2.0	Apparent	Nov-Apr	---	---	High-----	Low.
Algoa---------	C	Rare-------	---	---	1.5-2.0	Perched	Nov-Apr	---	---	High-----	Low.
Mc*:											
Mocarey-------	D	None-------	---	---	1.5-2.0	Apparent	Nov-Apr	---	---	High-----	Low.
Cieno---------	D	None-------	---	---	+1-1.0	Perched	Nov-May	---	---	High-----	Low.
Md:											
Mocarey-------	D	Rare-------	---	---	1.5-2.0	Apparent	Nov-Apr	---	---	High-----	Low.
Leton---------	D	Rare-------	---	---	0-1.5	Apparent	Oct-May	---	---	High-----	Moderate.
Me------------- Morey	D	Rare-------	---	---	0.5-2.0	Apparent	Dec-Feb	---	---	High-----	Low.
Mf:											
Morey---------	D	Rare-------	---	---	0.5-2.0	Apparent	Dec-Feb	---	---	High-----	Low.
Leton---------	D	Rare-------	---	---	0-0.5	Apparent	Oct-May	---	---	High-----	Moderate.
Mn------------- Mustang	D	Occasional	Brief	Aug-Nov	0-1.0	Apparent	Jan-Dec	---	---	High-----	Low.
Mp------------- Mustang	D	Frequent---	Brief to long.	Aug-Nov	0-0.5	Apparent	Jan-Dec	---	---	High-----	Moderate.
Ms:											
Mustang, slightly saline------	D	Occasional	Brief	Aug-Nov	0-0.5	Apparent	Jan-Dec	---	---	High-----	Low.
Mustang, strongly saline------	D	Frequent---	Brief to long.	Aug-Nov	0-0.5	Apparent	Jan-Dec	---	---	High-----	Moderate.
Mt*:											
Mustang-------	D	Occasional	Brief	Aug-Nov	0-0.5	Apparent	Jan-Dec	---	---	High-----	Low.
Nass----------	D	Occasional	Brief	Jun-Nov	+2-0	Apparent	Jan-Dec	---	---	High-----	Low.
Mu:											
Mustang-------	D	Occasional	Brief	Aug-Nov	0-1.0	Apparent	Jan-Dec	---	---	High-----	Low.
Urban land.											
Na------------- Narta	D	Rare-------	---	---	0-1.0	Perched	Sep-May	---	---	High-----	Moderate.
Ns*------------ Nass	D	Occasional	Brief	Jun-Nov	+2-0	Apparent	Jan-Dec	---	---	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Subsidence		Risk of corrosion	
		Frequency	Dura-tion	Months	Depth	Kind	Months	Initial	Total	Uncoated steel	Concrete
					Ft			In	In		
Nx*:											
Nass----------	D	Occasional	Brief	Jun-Nov	+2-0	Apparent	Jan-Dec	---	---	High-----	Low.
Galveston-----	A	Occasional	Very brief.	Jun-Oct	3.0-5.0	Apparent	Jan-Dec	---	---	High-----	Low.
Pa. Pits											
Pd------------- Placedo	D	Frequent---	Long---	Jan-Dec	0-0.5	Apparent	Jan-Dec	---	---	High-----	High.
Sa------------- Sabine	A	Rare-------	---	---	2.5-4.0	Apparent	Jan-Dec	---	---	High-----	Low.
SeB------------ Sievers	C	Rare-------	---	---	2.5-4.0	Apparent	Sep-May	---	---	High-----	High.
StA:											
Stowell-------	D	Occasional	Very brief.	Oct-Nov	1.5-4.0	Perched	Sep-Jun	---	---	High-----	Moderate.
Leton---------	D	Frequent---	Very brief to very long.	Oct-May	0-1.5	Apparent	Oct-May	---	---	High-----	Moderate.
Ta*------------ Tatlum	D	Frequent---	Very long.	Jan-Dec	+1-0	Apparent	Jan-Dec	1-4	1-4	High-----	High.
Tc, Tm, Tx----- Tracosa	D	Frequent---	Very long.	Jan-Dec	0-0.5	Apparent	Jan-Dec	1-2	1-2	High-----	High.
Va------------- Vamont	D	Rare-------	---	---	0-1.5	Apparent	Nov-Mar	---	---	High-----	Moderate.
Ve------------- Verland	D	Rare-------	---	---	0.5-1.5	Apparent	Nov-Apr	---	---	High-----	Moderate.
Vn------------- Veston	D	Occasional	Brief	Jun-Oct	1.0-2.0	Apparent	Jan-Dec	---	---	High-----	High.
Vs------------- Veston	D	Frequent---	Brief	Jun-Oct	0-1.0	Apparent	Jan-Dec	---	---	High-----	High.
Vx:											
Veston, strongly saline-------	D	Frequent---	Brief	Jun-Oct	0-0.5	Apparent	Jan-Dec	---	---	High-----	High.
Veston, slightly saline-------	D	Frequent---	Brief	Jun-Oct	0.5-2.0	Apparent	Jan-Dec	---	---	High-----	High.

* In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Algoa	Fine-loamy, thermic Aeric Calciaquolls
*Aris	Fine, mixed, thermic Typic Glossaqualfs
Bacliff	Fine, montmorillonitic, thermic Entic Pelluderts
Bernard	Fine, montmorillonitic, thermic Vertic Argiaquolls
*Caplen	Fine, montmorillonitic, nonacid, thermic Typic Hydraquents
*Cieno	Fine-loamy, siliceous, hyperthermic Typic Ochraqualfs
Edna	Fine, montmorillonitic, thermic Vertic Albaqualfs
Follet	Fine-silty, mixed, nonacid, hyperthermic Typic Haplaquents
Francitas	Fine, montmorillonitic, hyperthermic Typic Pelluderts
**Galveston	Mixed, hyperthermic Typic Udipsamments
Harris	Fine, montmorillonitic, thermic Typic Haplaquolls
Ijam	Fine, montmorillonitic, nonacid, thermic Vertic Fluvaquents
Karankawa	Coarse-loamy, mixed, nonacid, hyperthermic Typic Haplaquents
Kemah	Fine, montmorillonitic, thermic Typic Albaqualfs
Lake Charles	Fine, montmorillonitic, thermic Typic Pelluderts
Leton	Fine-silty, mixed, thermic Typic Glossaqualfs
Mocarey	Fine-loamy, mixed, thermic Typic Haplaquolls
Morey	Fine-silty, mixed, thermic Typic Argiaquolls
Mustang	Mixed, hyperthermic Typic Psammaquents
Narta	Fine, montmorillonitic, hyperthermic Typic Natraqualfs
**Nass	Coarse-loamy, mixed, hyperthermic Typic Haplaquents
Placedo	Fine, montmorillonitic, nonacid, hyperthermic Typic Fluvaquents
Sabine	Sandy, mixed, hyperthermic Entic Hapludolls
Sievers	Fine-loamy, mixed, hyperthermic Typic Fluvaquents
Stowell	Fine-loamy, mixed, thermic Typic Argialbolls
Tatlum	Fine-silty, mixed, nonacid, hyperthermic Typic Hydraquents
Tracosa	Fine, montmorillonitic, nonacid, hyperthermic Typic Haplaquents
Vamont	Fine, montmorillonitic, thermic Aquentic Chromuderts
Verland	Fine, montmorillonitic, thermic Vertic Ochraqualfs
Veston	Fine-silty, mixed, nonacid, hyperthermic Typic Fluvaquents

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

** Only some part of the soil is a taxadjunct to the series.

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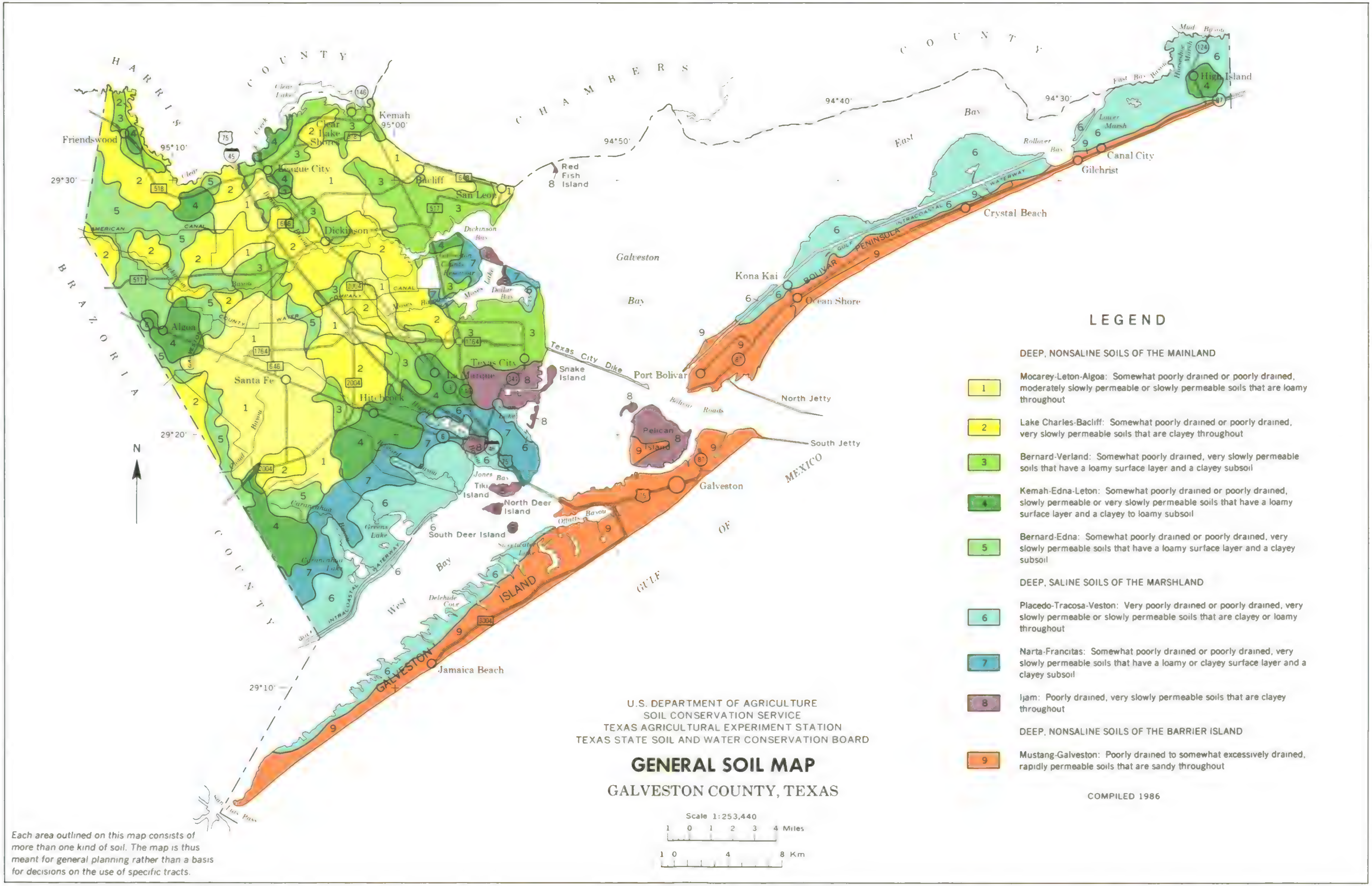
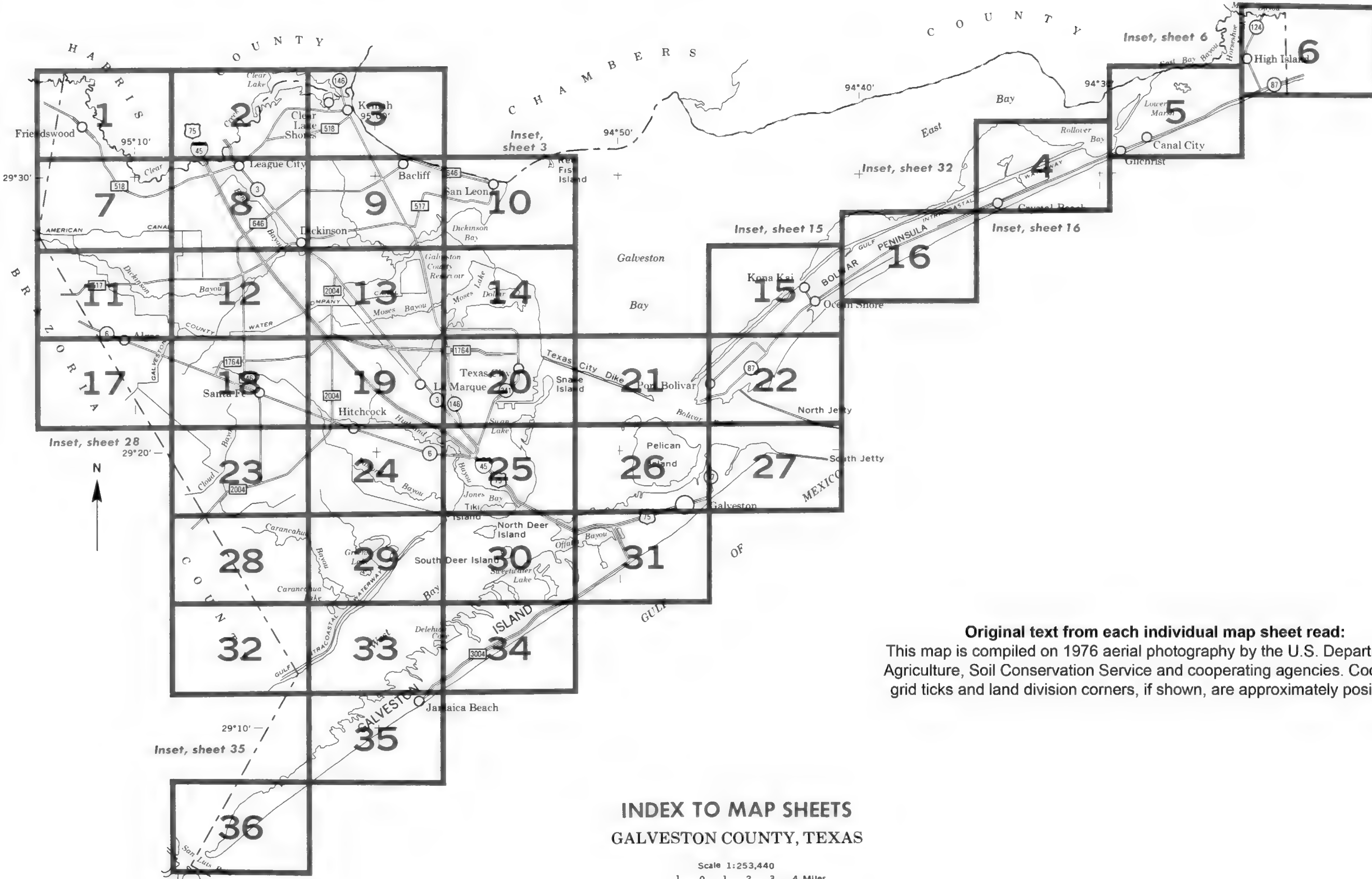

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION
TEXAS STATE SOIL AND WATER CONSERVATION BOARD
GENERAL SOIL MAP
GALVESTON COUNTY, TEXAS
Scale 1:253,440
1 0 1 2 3 4 Miles
1 0 4 8 Km
LEGEND
DEEP, NONSALINE SOILS OF THE MAINLAND
1 Mocarey-Leton-Algoa: Somewhat poorly drained or poorly drained, moderately slowly permeable or slowly permeable soils that are loamy throughout
2 Lake Charles-Bacliff: Somewhat poorly drained or poorly drained, very slowly permeable soils that are clayey throughout
3 Bernard-Verland: Somewhat poorly drained, very slowly permeable soils that have a loamy surface layer and a clayey subsoil
4 Kemah-Edna-Leton: Somewhat poorly drained or poorly drained, slowly permeable or very slowly permeable soils that have a loamy surface layer and a clayey to loamy subsoil
5 Bernard-Edna: Somewhat poorly drained or poorly drained, very slowly permeable soils that have a loamy surface layer and a clayey subsoil
DEEP, SALINE SOILS OF THE MARSHLAND
6 Placedo-Tracosa-Veston: Very poorly drained or poorly drained, very slowly permeable or slowly permeable soils that are clayey or loamy throughout
7 Narta-Francitas: Somewhat poorly drained or poorly drained, very slowly permeable soils that have a loamy or clayey surface layer and a clayey subsoil
8 Ijam: Poorly drained, very slowly permeable soils that are clayey throughout
DEEP, NONSALINE SOILS OF THE BARRIER ISLAND
9 Mustang-Galveston: Poorly drained to somewhat excessively drained, rapidly permeable soils that are sandy throughout
COMPILED 1986
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.
HARRIS COUNTY
CHAMBERS COUNTY
BRAZORIA COUNTY
Friendswood
League City
Kemah
Clear Lake Shores
Bacliff
San Leon
Dickinson
Algoa
Santa Fe
Hitchcock
La Marque
Texas City
Snake Island
Red Fish Island
Texas City Dike
Port Bolivar
North Jetty
South Jetty
Pelican Island
Galveston
Galveston Bay
East Bay
West Bay
Jones Bay
Tiki Island
North Deer Island
South Deer Island
Jamaica Beach
GALVESTON ISLAND
BOLIVAR PENINSULA
Kona Kai
Ocean Shore
Crystal Beach
Gilchrist
Canal City
High Island
Rollover Bay
GULF OF MEXICO
Bolivar Roads
94°40'
94°30'
94°50'
95°00'
95°10'
29°30'
29°20'
29°10'
N



Original text from each individual map sheet read:
This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS

GALVESTON COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

The first letter of the map symbol, always a capital, is the initial letter of the soil name. The second letter is a lower case letter. The third letter, if used, is a capital letter and denotes slope class. Symbols without a slope letter are for nearly level soils. Map unit names that do not list slope range have slope of less than 1 percent.

SYMBOL	NAME
AaB	Arents clayey, 0 to 3 percent slopes
Ar	Aris fine sandy loam
Ba	Bacliff clay
Bb	Beaches
Be	Bernard clay loam
Bn	Bernard-Edna complex
Bu	Bernard-Urban Land complex
Ca	Caplen mucky silty clay loam
Ct	Caplen-Tracosa complex
Ed	Edna fine sandy loam
Es	Edna-Aris complex
Fo	Follet loam
Fr	Francitas clay
GaB	Galveston fine sand, undulating
Gc	Galveston-Nass complex
Gd	Galveston-Urban land complex
Gs	Galveston loamy fine sand, shell substratum
Ha	Harris clay
ImA	Ijam clay, 0 to 2 percent slopes
ImB	Ijam clay, 2 to 8 percent slopes
Iu	Ijam-Urban land complex
Ka	Karankawa mucky loam
KeA	Kemah silt loam, 0 to 1 percent slopes
KeB	Kemah silt loam, 1 to 3 percent slopes
Ku	Kemah-Urban land complex
LaA	Lake Charles clay, 0 to 1 percent slopes
LaB	Lake Charles clay, 1 to 5 percent slopes
Lb	Lake Charles-Urban land complex
Le	Leton loam
Ls	Leton-Aris complex
Lx	Leton-Lake Charles complex
Ma	Mocarey loam
Mb	Mocarey-Algoa complex
Mc	Mocarey-Cieno complex
Md	Mocarey-Leton complex
Me	Morey silt loam
Mf	Morey-Leton complex
Mn	Mustang fine sand
Mp	Mustang fine sand, saline
Ms	Mustang fine sand, slightly saline-strongly saline complex
Mt	Mustang-Nass complex
Mu	Mustang-Urban land complex
Na	Narta fine sandy loam
Ns	Nass very fine sandy loam
Nx	Nass-Galveston complex, shell substratum
Pa	Pits, sand
Pd	Placedo clay
Sa	Sabine loamy fine sand
SeB	Sievers loam, 0 to 3 percent slopes
StA	Stowell-Leton complex, 0 to 2 percent slopes
Ta	Tatum mucky clay loam
Tc	Tracosa clay, low
Tm	Tracosa mucky clay
Tx	Tracosa mucky clay-clay, low complex
Va	Vamont clay
Ve	Verland silty clay loam
Vn	Veston loam, moderately saline
Vs	Veston loam, strongly saline
Vx	Veston loam, slightly saline-strongly saline complex

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

Swift Airport; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate (21)
- Federal (173)
- State (78)
- County, farm or ranch (1283)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small (water; w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — LaA, Tm

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown) — S

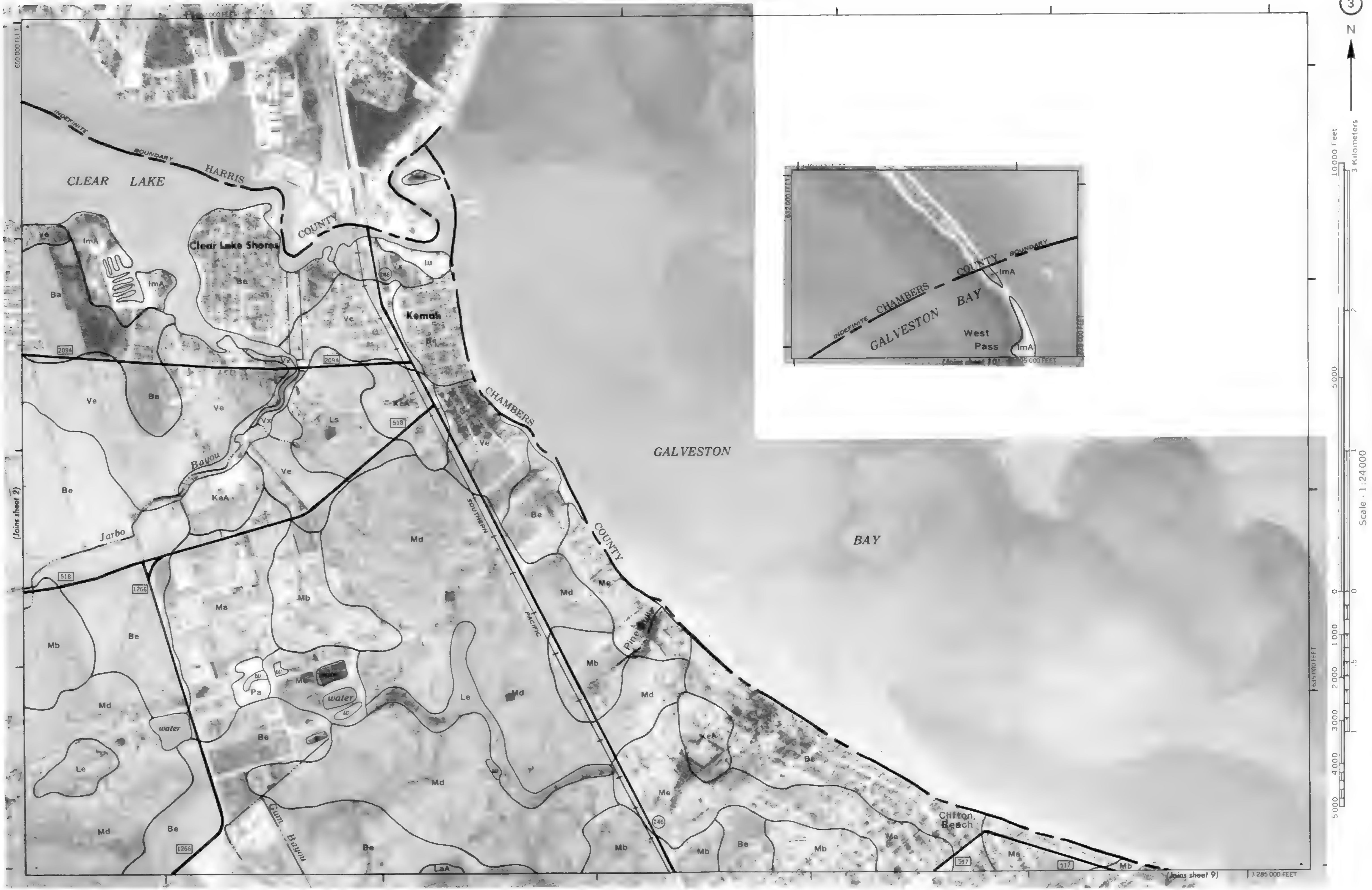
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Oil and sulphur waste spot

GALVESTON COUNTY, TEXAS — SHEET NUMBER 1


2
N
10 000 Feet
3 Kilometers
5 000
Scale 1:24 000
0
1000
2000
3000
4000
5 000
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 9)
3 230 000 FEET
630 000 FEET
COUNTY
BOUNDARY
INDEFINITE
HARRIS
CLEAR LAKE
ImA
Ve
Ba
Vx
LaA
Be
Ed
w
water
Creek
Clear
Bu
Robinson
Bayou
Mb
Me
LaB
KeA
SEWAGE DISPOSAL
GALVESTON COUNTY PARK
GALVESTON
HOUSTON
AND
HENDERSON
LEAGUE
CITY
Md
Le
HOUSTON GULF
AIRPORT
2094
518

GALVESTON COUNTY, TEXAS — SHEET NUMBER 3




4
N
EAST BAY
ROLLOVER BAY
Little Pasture Cove
Marsh Point
SUN OIL COMPANY CANAL
Ghost Bayou
Little Pasture Bayou
GULF INTRACOASTAL WATERWAY
BOLIVAR PENINSULA
Crab Lake
ROLLOVER PASS
Gilchrist
Caplen
GULF OF MEXICO
water
Ct
SeB
Tc
Tx
Ca
Pd
Fo
ImA
Ms
Mp
Sa
Mn
Vn
Vx
Ta
Bb
Mt
w
87
3 430 000 FEET
645 000 FEET
3 405 000 FEET
(Joins inset, sheet 16)
(Joins sheet 5)
Scale 1:24000
10000 Feet
3 Kilometers
5000
0
1000
2000
3000
4000
5000


5
N
(Joins inset, sheet 6)
(Joins sheet 6)
(Joins sheet 4)
Brushy Bend
ImA
Brushy Bend Bayou
Stought Bayou
CHAMBERS COUNTY
Brant Island
water
Knoll Ponds
Pd
EAST BAY
WATERWAY
INTRACOASTAL
GULF
Lower Marsh
Im
Mussel Point
Fo
Vs
Vx
Mn
Bb
Vn
Mp
Gilchrist
Mu
87
K&B
GULF OF MEXICO
3 460 000 FEET
10000 Feet
5 000
0
1 000
2 000
3 000
4 000
5 000
3 Kilometers
Scale - 1:24 000

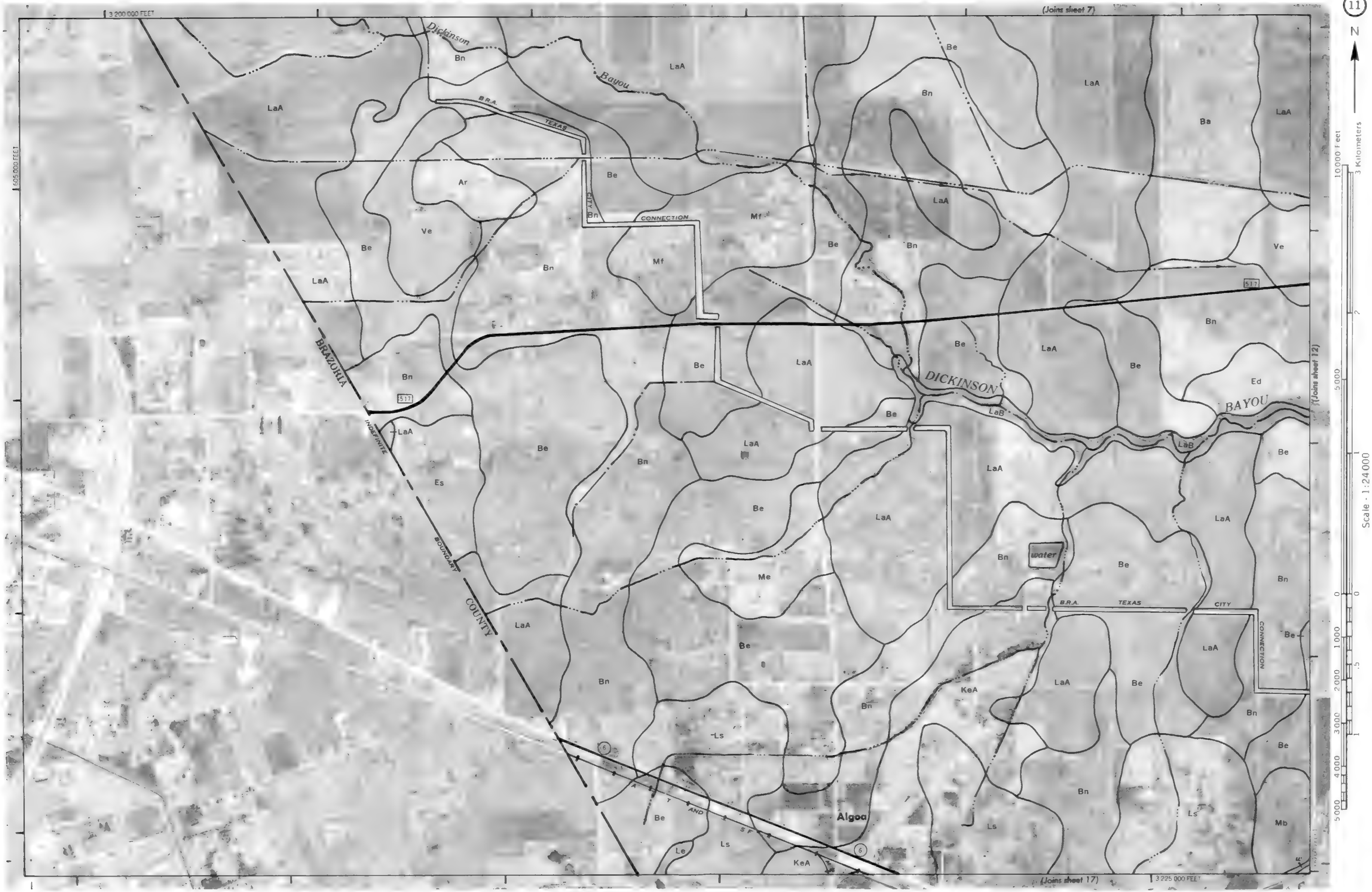

6
N
10000 Feet
3 Kilometers
Scale - 1:24 000
CHAMBERS COUNTY
Mud Bayou
water
ImA
Pd
Ha
Vs
Vn
Vx
KeA
KeB
Es
Mn
Bb
Clay Bottom Pond
Smith Pond
High Island
GULF OF MEXICO
(Joins inset)
(Joins sheet 5)
3 465 000 FEET
3 490 000 FEET
3 460 000 FEET
Horseshoe Bend
Horseshoe Marsh
GULF INTRACOASTAL WATERWAY
East Bay Bayou
Brushy Bend
Brushy Bend Bayou
Stought Bayou
(Joins upper left)


(Joins sheet 1)
(Joins sheet 8)
(Joins sheet 11)
3 200 000 FEET
3 225 000 FEET
625 000 FEET
610 000 FEET
CLEAR
HARRIS
COUNTY
CREEK
BRAZORIA
COUNTY
BOUNDARY
INDEFINITE
Chigger
Creek
Magnolia
Creek
Dickinson
Bayou
TEXAS
CITY
CONNECTION
B.R.A.
SYSTEM
water
N
Scale 1:24 000
Feet
Kilometers


8
N
(Joins sheet 2)
LEAGUE CITY
HOUSTON GULF AIRPORT
HARRIS COUNTY
Clear Creek
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 12)
GALVESTON HOUSTON AND HENDERSON
Benson
Magnolia Bayou
Bayou
DICKINSON BAYOU
Dickinson
water
3 230 000 FEET
3 250 000 FEET
610 000 FEET
630 000 FEET
Scale 1:24 000
3 Kilometers
10 000 Feet


9
N
(Joins sheet 3)
CHAMBERS COUNTY
3 260 000 FEET
630 000 FEET
HOUSTON GULF AIRPORT
Bacliff
Gum Bayou
SOUTHERN PACIFIC
Salt Bayou
Salt Lake
(Joins sheet 10)
San Leon
Dickinson
DICKINSON BAYOU
(Joins sheet 13)
10 000 Feet
3 Kilometers
Scale 1:24 000


10
N
Scale - 1:24 000
(Joins inset, sheet 3)
West Pass
Red Fish Island
Red Fish Bar
ImA
Mb
Ellis Airfield
Md
Ma
Be
Mb
CHAMBERS COUNTY INDEFINITE BOUNDARY
Eagle Point
Bayou
Fo
Ve
San Leon
Factory
Na
Ve
Na
ImA
Cat Point
April Fool Point
DICKINSON BAY
GALVESTON BAY
ImA
Fo
KeA
Le
ImB
Fr
(Joins sheet 9)
(Joins sheet 14)
3 290 000 FEET
3 310 000 FEET
630 000 FEET
615 000 FEET

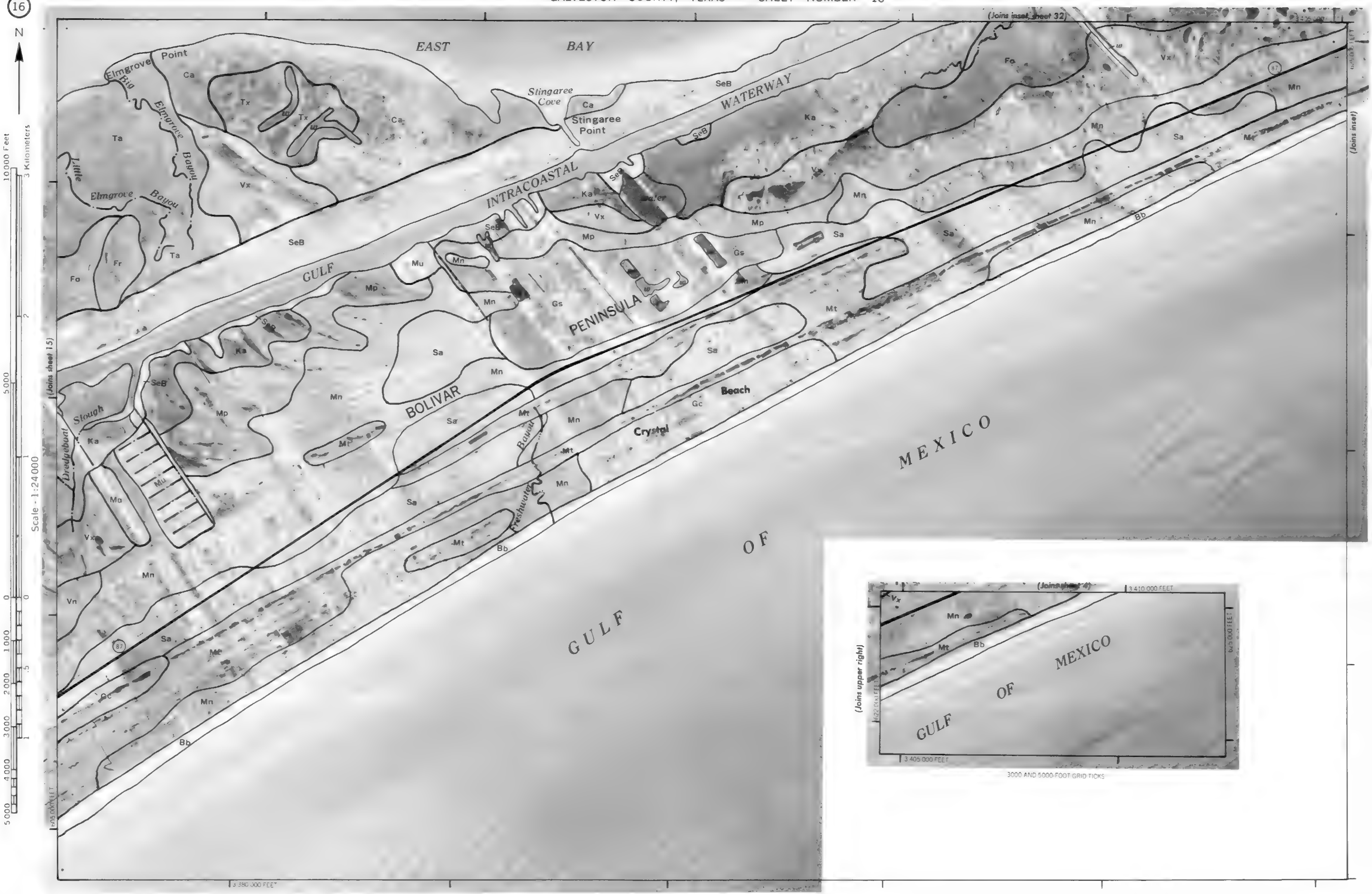

11
N
(Joins sheet 7)
(Joins sheet 12)
(Joins sheet 17)
3 200 000 FEET
3 225 000 FEET
605 000 FEET
Dickinson Bayou
DICKINSON BAYOU
B.R.A. TEXAS CITY CONNECTION
BRAZORIA COUNTY INDEFINITE BOUNDARY
A T AND S F
517
6
Algoa
water
LaA
Bn
Be
Ar
Ve
Mf
Es
Me
Ls
Le
KeA
LaB
Ed
Ba
Mb
Scale 1:24000
3 Kilometers
10000 Feet
5000
0
1000
2000
3000
4000
5000
.5
1
2


12
N
(Joins sheet 8)
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 18)
Borden Gully
Cedar Creek
DICKINSON BAYOU
DICKINSON
BAYOU
B.R.A. TEXAS CITY CONNECTION
GALVESTON SYSTEM
B.R.A. GALVESTON SYSTEM
3 230 000 FEET
3 255 000 FEET
595 000 FEET
Scale 1:24 000
10000 Feet
3 Kilometers
LaA
LaB
Be
Bn
Mf
Mc
Ma
Mb
Md
Me
Ve
Va
Ba
Ed
Le
Ar
517
646
75
45


13
(Joins sheet 9)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 19)
3 260 000 FEET
3 285 000 FEET
DICKINSON
BAYOU
Galveston County Industrial
Water Reservoir
Hulen Park
GALVESTON
HOUSTON
AND
HENDERSON
SYSTEM
SOUTHERN
PACIFIC
B.R.A.
GALVESTON
Moses
Bayou
water
N
Scale - 1:24 000
10000 Feet
3 Kilometers
5000
1000
2000
3000
4000
5000
0
1
2
3
.5


14
N
(Joins sheet 10)
(Joins sheet 13)
(Joins sheet 20)
3 310 000 FEET
610 000 FEET
3 290 000 FEET
Scale 1:24 000
3 Kilometers
10 000 Feet
SHELL ISLAND
Miller Point
Dollar Point
MOSES LAKE
DOLLAR BAY
GALVESTON BAY
Gulf Coast Airport
TEXAS CITY
KeA
Ve
Fr
ImA
ImB
Fo
Be
Na
KeA
Le
Vx
Me
Mf
Ed
StA
Ku
Ba
Lx
Ml
water
w


15
N
GALVESTON BAY
EAST BAY
Little Elmgrove Bayou
Pepper Grove Cove
water
PENINSULA
BOLIVAR
(Joins upper right)
(Joins sheet 16)
(Joins inset)
Sievers Cove
WATERWAY
INTRACOASTAL
GULF
PENINSULA
BOLIVAR
Dredgeboat Slough
GULF OF MEXICO
(Joins sheet 22)
Fo
Ka
SeB
Vx
Vn
Mn
Sa
Mt
Bb
Vs
GaB
87
Scale - 1:24 000
3 Kilometers
10 000 Feet
5000
3 350 000 FEET
3 370 000 FEET
3 375 000 FEET
610 000 FEET
620 000 FEET
600 000 FEET


16
N
EAST BAY
Elmgrove Point
Big Elmgrove Bayou
Little Elmgrove Bayou
Stingaree Cove
Stingaree Point
GULF INTRACOASTAL WATERWAY
BOLIVAR PENINSULA
Crystal Beach
Dredgeboat Slough
Freshwater Bayou
GULF OF MEXICO
(Joins inset, sheet 32)
(Joins inset)
(Joins sheet 15)
(Joins sheet 4)
(Joins upper right)
87
Ca
Tx
Ta
Vx
Fr
Fo
SeB
Ka
Mu
Mn
Mp
Gs
Sa
Mt
Gc
Bb
Ma
Vn
3 380 000 FEET
3 410 000 FEET
3 405 000 FEET
3000 AND 5000-FOOT GRID TICKS
Scale 1:24 000
10 000 Feet
3 Kilometers
5000
0
1000
2000
3000
4000
5 000


17
N
(Joins sheet 11)
Algoa
3 200 000 FEET
585 000 FEET
575 000 FEET
3 225 000 FEET
(Joins sheet 18)
(Joins sheet 28)
BRAZORIA
INDEFINITE
BOUNDARY
COUNTY
ATCHISON
TOPEKA
AND
SANTA FE
GALVESTON
SYSTEM
B.R.A.
B.R.A. SYSTEM B
B.R.A.
HALL'S
BAYOU
RANCH
CANAL
Be
Le
Ls
KeA
Bn
Mb
Ar
Md
Pa
Me
Bn
LaA
Ve
Scale - 1:24 000
3 Kilometers
10000 Feet
5000
0
1000
2000
3000
4000
5000
2
1
.5
0


18
N
10000 Feet
3 Kilometers
5000
Scale 1:24000
0
1000
2000
3000
4000
5000
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 23)
3 230 000 FEET
B.R.A. GALVESTON SYSTEM
Arcadia
Alta Loma
ATCHISON
TOPEKA
AND
SANTA FE
Highland
Bayou
Cloud
Bayou
B.R.A. HALL'S BAYOU RANCH CANAL
1764
646
6
Mb
Ar
Ma
Md
Mc
Be
Le
LaA
AaB
Me
Ve
w

19
N
(Joins sheet 13)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 24)
3 250 000 FEET
3 285 000 FEET
GALVESTON COUNTY
MEMORIAL HOSPITAL
LA MARQUE
Volk Airfield
Marchand
Bayou
HIGHLAND
BAYOU
GALVESTON HOUSTON AND HENDERSON
water
Scale - 1:24 000
3 Kilometers
10 000 Feet
5 000
0
1 000
2 000
3 000
4 000
5 000


20
N
(Joins sheet 14)
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 25)
Gulf
Coast
Airport
TEXAS CITY
TEXAS CITY DIKE
SNAKE ISLAND
GALVESTON BAY
SWAN LAKE
Reservoir
water
BARGE CANAL
TEXAS CITY
LaA
Lx
Mt
Ma
Ed
Ku
KeA
ImB
ImA
StA
Ba
Ve
Es
Iu
Fo
Na
Fr
Tm
Scale - 1:24 000
3 Kilometers
10 000 Feet
5 000
0
1 000
2 000
3 000
4 000
5 000
3 315 000 FEET
590 000 FEET


21
N
GALVESTON
BAY
TEXAS
CITY
DIKE
Iu
GULF
INTRACOASTAL
WATERWAY
SeB
Mn
Port
Bolivar
2612
Mp
Sa
Ns
Mt
Horseshoe
Lake
Ms
Ka
ImA
Mu
Tidal
Flat
PELICAN
ISLAND
SeB
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 26)
3 320 000 FEET
3 345 000 FEET
590 000 FEET
575 000 FEET
Scale - 1:24 000
10 000 Feet
3 Kilometers
5000
4000
3000
2000
1000
0


22
N
(Joins sheet 15)
(Joins sheet 21)
GALVESTON BAY
GULF INTRACOASTAL WATERWAY
Baffle Point
BOLIVAR PENINSULA
Port Bolivar
Horseshoe Lake
Fort Travis
GULF OF MEXICO
North Jetty
SeB
Mn
GaB
Gc
Mt
Mp
Ms
Ka
Ss
Bb
2612
87
Scale 1:24 000
10 000 Feet
3 Kilometers
5000
0
1000
2000
3000
4000
3 375 000 FEET
3 350 000 FEET
580 000 FEET
590 000 FEET


23
N
(Joins sheet 18)
(Joins sheet 24)
(Joins sheet 28)
(Joins inset, sheet 28)
3 230 000 FEET
3 255 000 FEET
570 000 FEET
555 000 FEET
Scale - 1:24000
10 000 Feet
3 Kilometers
BRAZORIA COUNTY
INDEFINITE BOUNDARY
B.R.A. HALL'S BAYOU RANCH CANAL
Cloud Bayou
Willow Bayou
646
2004
Ve
Be
Mb
Md
Bn
LaA
Lx
Mc
Ls
Me
Mf
AaB
w


24
N
(Joins sheet 19)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 29)
HITCHCOCK
HIGHLAND BAYOU
ATCHISON TOPEKA AND SANTA FE
SEWAGE DISPOSAL
Basford Bayou
water
Scale 1:24 000
10 000 Feet
3 Kilometers
3 285 000 FEET
3 260 000 FEET


25
N
(Joins sheet 20)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 30)
3 290 000 FEET
3 315 000 FEET
555 000 FEET
SWAN LAKE
Campbell Bayou
HIGHLAND BAYOU
GALVESTON BAY
JONES BAY
WILSON POINT
GALVESTON HOUSTON AND HENDERSON
ATCHISON TOPEKA AND SANTA FE
water
Na
Fo
Fr
ImA
ImB
Tm
Le
Iu
Tx
Tc
Vx
w
Scale - 1:24 000
10 000 Feet
5000
0
1000
2000
3000
4000
5000
3 Kilometers
2
1
.5
0


N
Scale - 1:24 000
10 000 Feet
3 Kilometers
GULF INTRACOASTAL WATERWAY
PELICAN SPIT MILITARY RESERVATION
PELICAN ISLAND
GALVESTON BAY
GALVESTON CHANNEL
UNIVERSITY OF TEXAS MEDICAL COLLEGE
OLD FORT SAN JACINTO
GALVESTON
(county seat)
GULF OF MEXICO
HENDERSON
HOUSTON
GALVESTON
(Joins sheet 21)
(Joins sheet 27)
ImA
ImB
Mp
SeB
Mn
Iu
Id
Gd
Mt
Bb
Ms
W

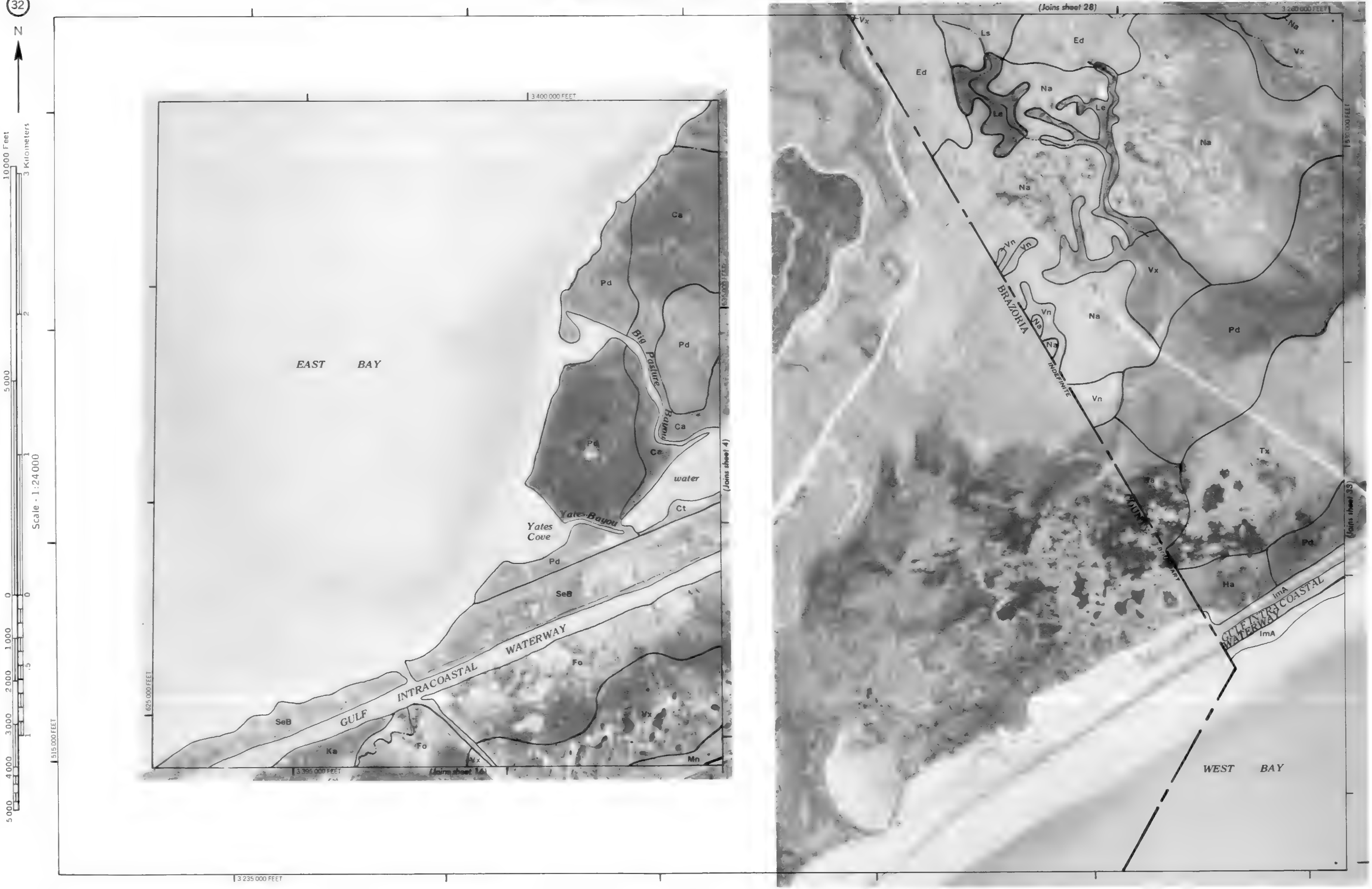

27
(Joins sheet 22)
3 350 000 FEET
575 000 FEET
NORTH JETTY
Tidal Flat
Fort Point
Big Reef
Bb
Mn
Mp
THE LAGOON
Ka
Ns
OLD FORT
SAN JACINTO
Gd
Mt
Mu
EAST BEACH
(Joins sheet 26)
SOUTH JETTY
GULF OF MEXICO
N
Scale - 1:24 000
10 000 Feet
3 Kilometers
560 000 FEET
3 375 000 FEET

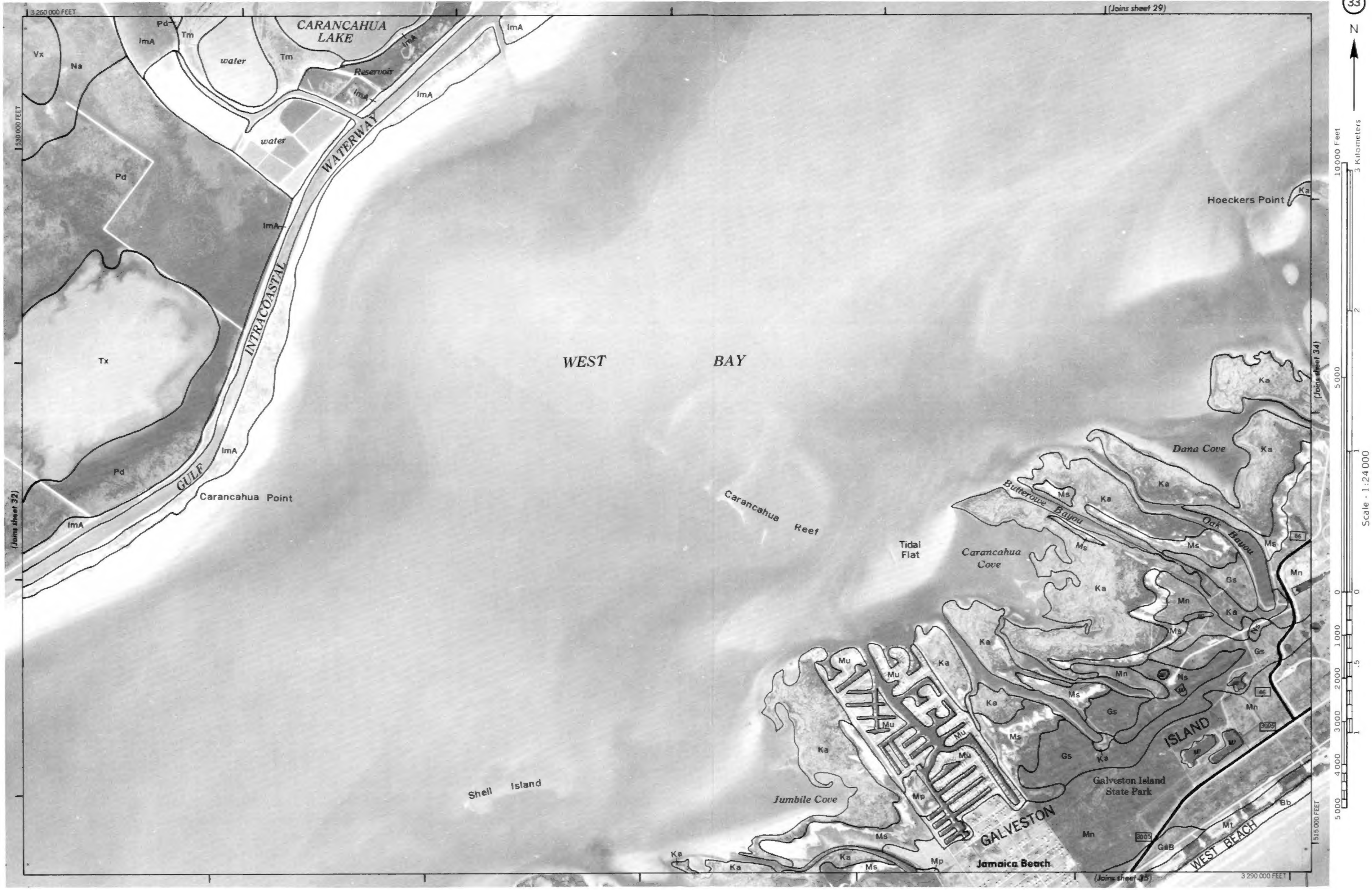

28
N
(Joins sheet 23)
3 255 000 FEET
550 000 FEET
(Joins sheet 29)
(Joins sheet 32)
3 235 000 FEET
535 000 FEET
(Joins sheet 17)
3 229 000 FEET
570 000 FEET
3 225 000 FEET
4000 AND 5000 FOOT GRID TICKS
Scale 1:24 000
10 000 Feet
3 Kilometers
BRAZORIA
COUNTY
BOUNDARY
INDEFINITE
CARANCAHUA
BAYOU
Willow
Bayou
Hulls
Bayou
Be
Bn
Ba
Ls
Mc
LaA
Mf
Na
Fr
Pd
Es
Ed
Le
ImA
Vn
Vx
Ve


29
N
(Joins sheet 24)
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 33)
GREENS LAKE
WEST BAY
CARANCAHUA BAYOU
CARANCAHUA LAKE
GULF INTRACOASTAL WATERWAY
3 260 000 FEET
3 285 000 FEET
535 000 FEET
water
Scale - 1:24 000
3 Kilometers
10000 Feet
5000
0
1000
2000
3000
4000
5000

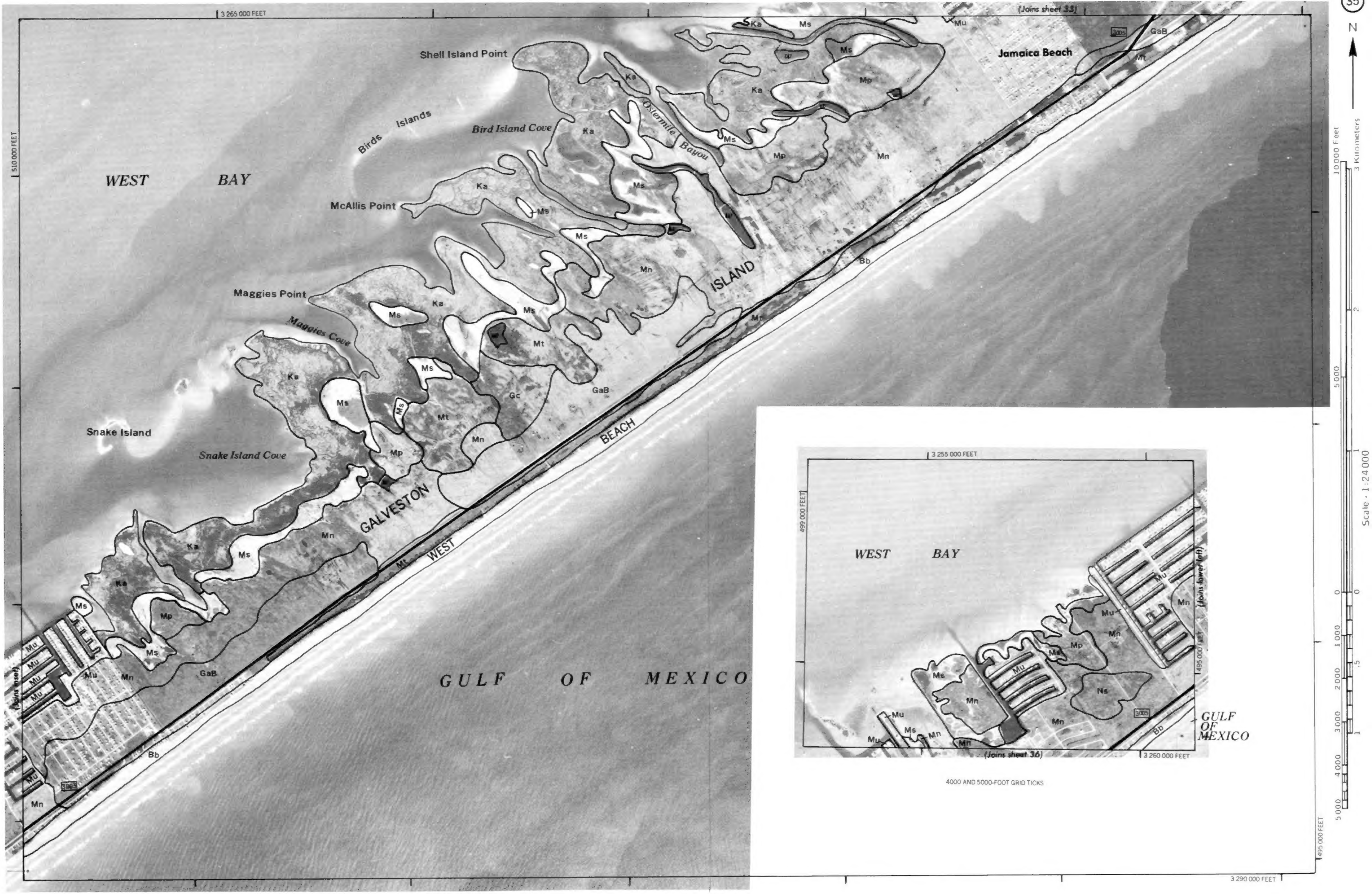

30
N
(Joins sheet 25)
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 34)
WILSON POINT
GULF
INTRACOASTAL
WATERWAY
NORTH DEER ISLAND
Middle Deer Island
SOUTH DEER ISLAND
WEST BAY
WEST BAY
Tiechman Point
OFFATT BAYOU
SCHOLES AIRFIELD
Sydnor Bayou
SWEETWATER LAKE
GALVESTON ISLAND
Gangs Bayou
Oxen Bayou
Melager Cove
GULF OF MEXICO
water
water
ImA
Fo
SeB
Ka
Gd
Mn
Mp
Mu
Mt
Gc
Ms
Nx
Bb
45
75
3005
A.T. AND S.F.
3 290 000 FEET
535 000 FEET
Scale 1:24 000
10 000 Feet
3 Kilometers

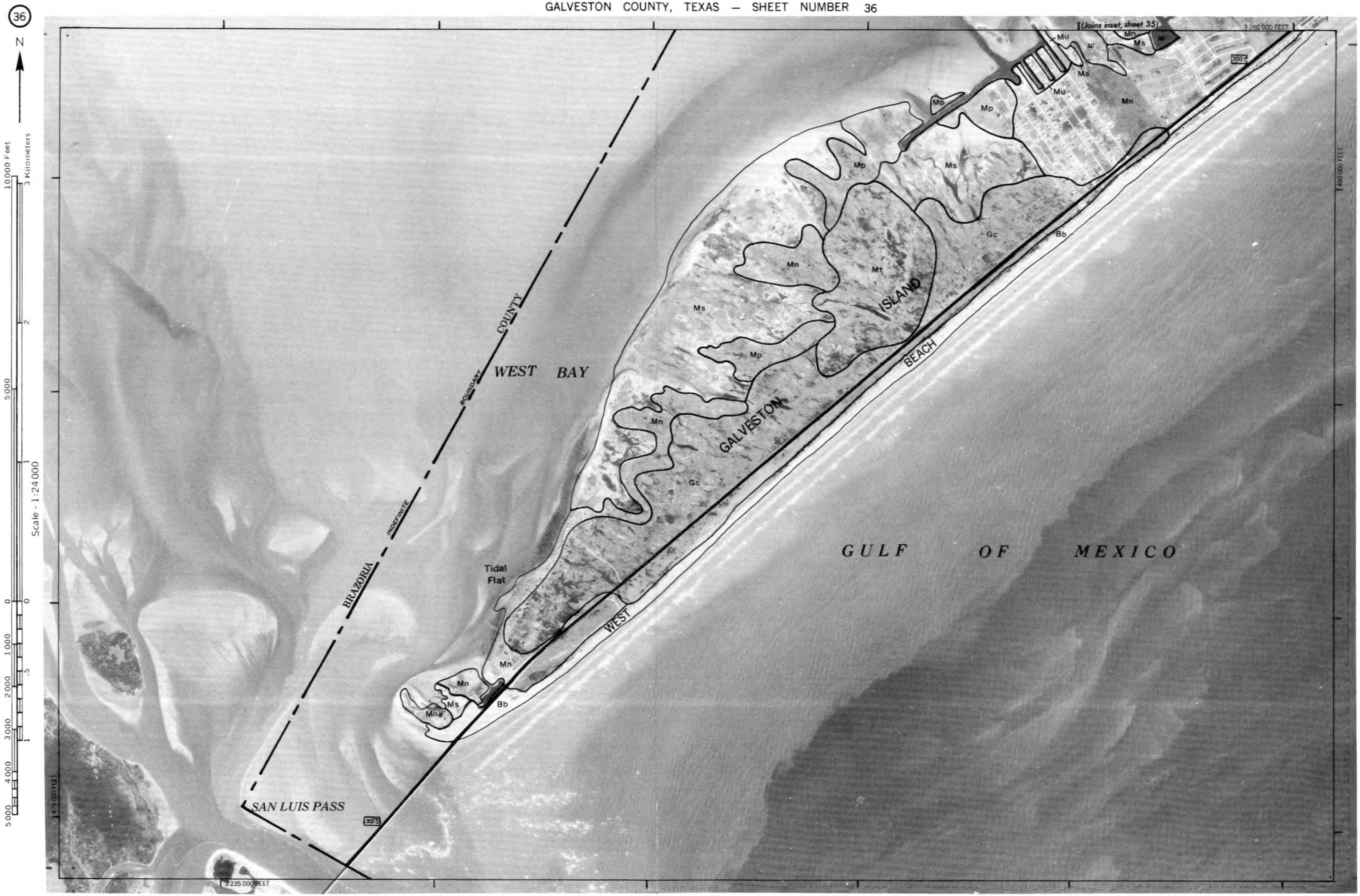

31
N
GALVESTON
(county seat)
OFFATT BAYOU
SCHOLES AIRFIELD
GULF OF MEXICO
Greens Bayou
Sydnor Bayou
(Joins sheet 30)
(Joins sheet 26)
G H AND H
A T AND S F
water
Gd
Mp
Mn
Mt
Ka
45
75
342
3005
3 320 000 FEET
3 345 000 FEET
540 000 FEET
Scale 1:24 000
10 000 Feet
5000
0
1000
2000
3000
4000
5000
3 Kilometers
2
1
.5
0


32
N
Scale - 1:24 000
10 000 Feet
3 Kilometers
5 000
1 000
2 000
3 000
4 000
0
1
2
.5
(Joins sheet 28)
(Joins sheet 16)
(Joins sheet 4)
(Joins sheet 33)
3 400 000 FEET
3 395 000 FEET
3 260 000 FEET
3 235 000 FEET
625 000 FEET
615 000 FEET
510 000 FEET
EAST BAY
WEST BAY
Big Pasture Bayou
Yates Bayou
Yates Cove
water
GULF INTRACOASTAL WATERWAY
BRAZORIA
INDEFINITE
BOUNDARY
Ca
Pd
Ct
SeB
Fo
Vx
Ka
Mn
Ed
Ls
Le
Na
Vn
Tx
Ha
ImA


33
N
3 260 000 FEET
530 000 FEET
(Joins sheet 29)
(Joins sheet 32)
(Joins sheet 34)
(Joins sheet 35)
3 290 000 FEET
515 000 FEET
CARANCAHUA LAKE
Reservoir
water
water
INTRACOASTAL
WATERWAY
GULF
Carancahua Point
WEST
BAY
Carancahua Reef
Tidal Flat
Carancahua Cove
Butterowe Bayou
Oak Bayou
Dana Cove
Hoeckers Point
Shell Island
Jumbile Cove
GALVESTON
ISLAND
Galveston Island State Park
Jamaica Beach
WEST BEACH
Vx
Na
Pd
ImA
Tm
Tx
Ka
Ms
Mn
Gs
Ns
Mu
Mp
Mt
GsB
Bb
66
3005
Scale - 1:24000
10 000 Feet
5 000
0
1000
2000
3000
4000
5000
3 Kilometers
2
1
.5
0
1


N
Scale - 1:24 000
10 000 Feet
3 Kilometers
(Joins sheet 30)
(Joins sheet 33)
WEST BAY
Melager Cove
Mensell Bayou
Starvation Cove
Oyen Bayou
Gangs Bayou
Hoeckers Point
Eckert Bayou
Delehide Cove
Lake Como
GALVESTON
ISLAND
WEST
BEACH
GULF OF MEXICO
water
515 000 FEET
535 000 FEET
3 295 000 FEET
3 315 000 FEET
3005
66


3 265 000 FEET
(Joins sheet 33)
510 000 FEET
WEST BAY
Birds Islands
Shell Island Point
Bird Island Cove
Ostermile Bayou
Jamaica Beach
McAllis Point
Maggies Point
Maggies Cove
Snake Island
Snake Island Cove
GALVESTON ISLAND
WEST BEACH
GULF OF MEXICO
(Joins inset)
3005
3 255 000 FEET
499 000 FEET
WEST BAY
(Joins lower left)
495 000 FEET
GULF OF MEXICO
(Joins sheet 36)
3 260 000 FEET
4000 AND 5000-FOOT GRID TICKS
495 000 FEET
3 290 000 FEET
N
Scale - 1:24 000
10 000 Feet
3 Kilometers


36
N
10 000 Feet
3 Kilometers
5000
Scale - 1:24 000
0
1000
2000
3000
4000
5000
(Joins inset, sheet 35)
3 260 000 FEET
490 000 FEET
WEST BAY
BRAZORIA
INDEFINITE
BOUNDARY
COUNTY
SAN LUIS PASS
GALVESTON
ISLAND
WEST
BEACH
GULF OF MEXICO
Tidal Flat
Mu
Mn
Ms
Mp
Mt
Gc
Bb
Mne
3 235 000 FEET